THE FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE USEFUL ARTS, INTERNAL IMPROVEMENTS,
AND GENERAL SCIENCE.

UNDER THE PATRONAGE

OF THE

FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA.

EDITED BY Dr. THOMAS P. JONES.

PROFESSOR OF MECHANICS IN THE INSTITUTE.

Vol. I.

PHILADELPHIA:
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1826

PREFACE.

As a few prefatory remarks will be expected on the completion of the first volume of this journal, the editor avails himself of the opportunity thus presented, to say, that he has experienced much gratification, from that approbation of the work, which has been expressed by persons whose favourable opinions are highly valuable.

Every new undertaking, presents in its progress, unanticipated difficulties, which require time and perseverance for their removal; to those which necessarily attend a work of this description, others, resulting from the situation of the editor, have, in the present instance, been superadded. The history of his peculiar situation, would be altogether uninteresting to the public, whatever may have been its effects; and he only alludes to it, for the purpose of saying, that it has had an influence on his past labours, but that he feels confident his future pages, will more completely redeem the pledges given in his address, at the commencement of the work.

In his progress, the editor has aimed to present scientific views, and at the same time to arrive at practical utility. Originality, although to a certain extent desirable, has not been deemed to be of primary importance; the end proposed, will probably be best attained, by judicious selections; and the means of making

these, are increasing, by the reception of foreign journals, devoted to similar objects, the effect of which will be evident in the succeeding numbers. Many valuable original papers have, however, been presented, and the continued contributions of those to whom the editor is already indebted, are confidently anticipated, whilst he has an assurance of similar aid, from others.

The pen of the editor has been but sparingly used; he however possesses much practical knowledge, with some science; and although the circumstances hinted at, have hitherto interfered to prevent the full evidence of this, on the pages of his journal, he trusts that his assumption on these points, will hereafter be completely justified.

From the encouragement already received, no doubt now remains of the permanence of the work. Any hints for its improvement will always be acceptable, and shall receive due attention.

Philadelphia, June 1, 1826.

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JANUARY, 1826.

ADDRESS.

The prospectus of the 'Franklin Journal,' has been for some months before the public; at the time it was issued, the Editor resided in a distant part of the United States, and was engaged in a pursuit which prevented his removal to Philadelphia, until the commencement of the present year. It was his intention to publish the first number early in January; this, however, he has not been able to effect; yet he has thought it best to antidate it a month, as he will in the course of the year complete twelve numbers, making two volumes of nearly four hundred pages each.

It was at first proposed to publish a single sheet every week, in the manner of the "Mechanics' Magazine," and other similar works published in London; but the Editor has, upon mature consideration, deemed it expedient to make it a monthly, instead of a weekly publication; and he presumes that the reasons which have weighed with him in making this alteration, will be satisfactory to his subscribers generally. He is unwilling that this Journal should be a mere book of recipes and notices, "a thing of shreds and patches;" this would neither satisfy the Editor, or supply the wants of the intelligent artisans and manufacturers of our country. Every number will contain a variety of processes in the mechanical and chymical arts; but it is intended also to insert articles of general interest, and of greater length than would be found convenient on a single sheet: it is also designed to embrace a greater variety of topics than was at first contemplated, and in general to devote a part of every number, to each of the leading subjects included in the work.

Under the following heads will be introduced a great variety of matter, interesting to the artisan, and to the man of general reading.

1st. The transactions of the Franklin Institute, and of other similar establishments.—2nd. Mechanics, and Natural Philosophy.—3d. Chymistry, particularly in its application to the arts.—4th. American inventions and discoveries, whether patented or not.—5th. American manufactures.—6th. Internal improvements.—

7th. Natural History.—8th. Mineralogy.—9th. Botany.—10th. Mathematics.—11th. Architecture.—12th. Popular Education.—13th. Husbandry and Rural affairs, particularly as regards the implements used; and the production of silk, flax, wool, cotton, dye-stuffs, and other articles employed in manufactures.—14th. Mechanical Jurisprudence.—15th. Foreign Journals, inventions, discoveries, and patents.—16th. Notices and Reviews of Publications relating to Arts and Manufactures.—17th. Miscellaneous articles, consisting of recipes, processes, &c.

It will readily be perceived that a number of subjects are mentioned, with which the Editor cannot pretend to be familiarly acquainted; he has not, however, "reckoned without his host," as he is assured of the aid of gentlemen, whose stations and talents are a sufficient pledge for the able manner in which they will fulfil their engagements. All the articles of general interest, emanating from the "Society for the encouragement of Internal Improvements," will pass through the hands of the Editor, and will occupy a portion of every number. The journals of our own country, devoted to science and the mechanic arts, and those of England, France and Germany, will be carefully examined, and their most useful materials employed: when not written in a style intelligible to the generality of readers, they will be in this respect altered; and when unnecessarily prolix, abridged.

Gentlemen who furnish communications for the Franklin Journal, are requested always to keep in view, that its main object is to diffuse information among artisans and manufacturers; and that it is therefore necessary to write in a style as familiar, and as little technical, as the nature of the subject will admit. The Editor will claim, and exercise the right of acting according to his own judgment, respecting every article communicated for publication; and when the author is unknown, he will either insert, reject, alter or abridge, as he may deem best. He earnestly solicits the aid of intelligent mechanics and manufacturers; and assures them that although they may not always be as ready with the pen, as with the implements of their respective trades, their offerings will be acceptable; and that the labour of revision, when requisite, will be cheerfully performed.

The age of secrets in arts and trades, has nearly passed away; in these pursuits, as well as in that of commerce, liberal views are generally entertained, and a free and open intercourse is acknowledged to be the best policy. The Journal will be a ready vehicle for enquiries and replies upon all subjects within its purview; and will enable the artisan and others, to obtain information which might otherwise be sought in vain.

Patentees who wish to make their inventions known through the medium of the Journal, will be expected in all instances, to furnish the plates or cuts necessary for that purpose; and must submit to a free, but liberal examination into the originality and merits of their inventions.

The Editor will willingly open his work to the discussion of every subject upon which it treats; in doing this he will carefully avoid appearing as a partisan; but will act as moderator, so far as to prevent his pages from being sullied by malevolence, or offensive personalities.

CONDITIONS.—The Journal will be published monthly; each number will contain sixty-four pages, octavo; forming, annually, two volumes of nearly four hundred pages each. It will be printed on good paper, with well executed engravings on wood, and occasionally on copper.

Subscription, $4 per annum, payable on the completion of the first volume. Single numbers, 50 cents each. Subscribers in the city, will be served by a carrier; those at a distance, may receive the numbers by mail, or in any way they may direct.

Advertisements relating to the Mechanic Arts, will be inserted on the covers, on the usual terms.

All communications must be *post paid*, and may be addressed to the Editor, or to Judah Dobson, Agent, No. 103 Chesnut-street, Philadelphia.

FRANKLIN INSTITUTE.—EIGHTH QUARTERLY REPORT.

On Thursday, the 19th of January, the Board of Managers of the Institute presented their Eighth Quarterly Report, of which the following is an abstract:—

The Institution has, within the last year, flourished beyond the anticipations of its warmest friends. At its commencement, there were only five hundred and sixty Members—the number now amounts to one thousand and sixty-five. At that time, there was no probability of the funds of the Institute enabling it at any early period, to erect a building commensurate with its growing wants; there is now in south Seventh near Market-street, an elegant Hall nearly finished; sixty feet front, by one hundred feet deep; which, after affording ample accommodations for the Institute, will bring an annual rent of two thousand dollars; a sum which will more than pay the interest upon the purchase money for the ground, and the cost of erecting the edifice. The second story has been rented to the Marshal of the United States, for the use of the District Court, for ten years, at the annual rent of one thousand five hundred dollars. This part was completed, and the key delivered, on the 31st of December last. It is confidently expected, that the remainder of the building will be fit for occupancy on the 15th of May next.

The whole expense of the building, including the purchase of the ground, and sundry additional articles not included in the first estimate, will be thirty-five thousand five hundred dollars; of which sum, twenty-nine thousand six hundred dollars, have been already raised on loan, at five per cent. irredeemable until the year 1840.

The permanent fund which, a year ago, amounted to only five hundred and ten dollars fifty-two cents, has been increased by subscriptions, donations, the sale of apprentices' tickets, and interest, to one thousand seven hundred and ninety-nine dollars ninety-five cents; besides which, a balance remains in the hands of the Treasurer, liable to be appropriated to the current expenses of the Institute.

The second annual exhibition, has completely dissipated all those fears respecting the final success of this measure, which the difficulties attending the first attempt, had produced in the minds of the Managers. Few, if any, exhibitions of American manufactures, have ever presented such a variety of splendid, tasteful, and well executed goods; embracing many of the most important arts, and evincing a great progress in the extent of our manufactures, as well as a great improvement in their execution.

The course of instruction has been considerably extended; and includes at this time, regular lectures on Chymistry, Mechanics and Natural History, besides occasional volunteer lectures on Miscellaneous subjects. There are two Schools; one for Mathematics, the other for Drawing; both of which are well attended. The chair of Mechanics, which had been reserved until a suitable candidate should present himself, has been conferred on Dr. Jones, who entered upon its duties on the 4th instant; Dr. Patterson having kindly lectured in Dr. Jones' place, until his arrival. Mr. Keating's lectures on Chymistry as applied to the arts, have been continued and

extended. The course of lectures on Natural History, delivered by Dr. Godman, although on a subject less practical than those embraced by the other lecturers, has become a very popular part of the system, having been attended with such zeal and regularity, as to fill the room to overflowing.

The visit of Mr. Strickland to Europe, has prevented the delivery of his instructive and interesting lectures on Architecture; but it is expected the course will be resumed next fall.

The difficulties which, last year, prevented the publication of a Journal devoted to the objects which the Institute was designed to promote, have been obviated; Dr. Jones having consented to undertake it on his own account, whilst it is still considered as issued with the assistance of the Members, and under the patronage of the Institute.

An Almanac has also been published under the patronage of the Institute; which, it is believed, may do good in many parts of the state, where publications of a more expensive kind, rarely circulate.

The collections of the Institute are increasing; the models have been augmented; and it is hoped that when displayed in the new building, members and others will be induced to contribute such as are illustrative of their various arts. A large addition has been made to the Minerals; the Library is small, but increasing. Besides the Books and Minerals presented by sundry individuals, a handsome present of both, has been received from Mr. William Maclure.

The gratifying intelligence has been officially received, of the formation of a Society with similar objects, and on a similar plan, in the City of Baltimore; and another has lately been established in Boston.

PHILADELPHIA, January 19, 1826.

The Annual Meeting of the Franklin Institute, was held this evening, at half past six o'clock. JAMES RONALDSON, President, in the Chair. SAMUEL V. MERRICK, Secretary.

The Annual Reports of the Managers and Treasurer, were read, adopted, and ordered to be printed in the daily papers.

The tellers appointed to receive the votes for Officers to serve during the year 1826—Reported the following gentlemen duly elected.

PRESIDENT—James Ronaldson.
VICE-PRESIDENTS—Mathew Carey and Paul Beck, jr.
RECORDING SECRETARY—William Strickland.
CORRESPONDING SECRETARY—Peter A. Browne.
TREASURER—John Richardson.

MANAGERS.

Thomas Fletcher
John Harrison
William H. Keating
Samuel V. Merrick
Daniel Groves
Robert M. Patterson
James M'Alpin
Joseph Donaldson
Isaac B. Garrigues
William S. Warder

John Haviland
William Abbot
James Clarke
Abraham Miller
James Harper
Adam Ramage
Harvey Lewis
Lloyd Mifflin
A. G. Ralston
Rufus Tyler
James J. Rush
Samuel Humphreys
Henry J. Riehle
Thomas P. Jones

On motion, Resolved, That the meeting view with pleasure the prospect of the Franklin Journal being issued by so able an Editor as the Professor of Mechanics in the Institute, and recommend it to the support of their fellow citizens.

SAMUEL V. MERRICK, Secretary, P. T.

At a meeting of the Board of Managers of the Franklin Institute, held January 21, the following officers were elected.

CHAIRMAN—Thomas Fletcher.

CLERK—J. R. Warder.

CURATORS—T. P. Jones and S. V. Merrick.

Proposals of the Franklin Institute, for the Exhibition of October 1826, *addressed to the Manufacturers of the United States.*

The Managers of the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, having determined on Wednesday, October 3, 1826, for holding the third annual exhibition, they respectfully inform their fellow citizens of this arrangement; and invite, not only the manufacturers and artists of Pennsylvania, but those of all the Union, to send to this exhibition, the products of their industry, skill, and ingenuity.

Amongst the various objects of the Institution, that of making producers and purchasers acquainted with each other, and developing the capacities of the country to supply its wants, and sustain its commerce, is one in which the Managers take a deep interest; and to promote this important object, these exhibitions are established. Both parties are invited to give them their warmest support; producers by sending specimens of their goods, &c. and buyers by attending, and thereby becoming acquainted with what they can procure at home, on as good, or better terms than elsewhere.

At the previous exhibitions, every effort has been made to discharge the duties incumbent on the Managers, in such a manner as should serve all parties; and they feel gratified that their exertions have given so much satisfaction to the public. On the present occasion, an assurance is given that the same zeal and attention will characterize the ensuing October exhibition.

It being impossible for the Managers to make a proper arrangement of the articles, if not received previously to opening the exhibition, it will be indispensable, that goods should be at the place of deposit, on, or before the 29th day of September; and as one of the objects of this exhibition is to give activity to industry, the Managers leave it to every depositer, to take such means of publishing his

prices and terms, as in his judgment shall appear best; but it is required, that the owner's name and place of residence, shall be attached to the articles.

The following premiums are offered to promote the industry, skill, ingenuity, and enterprise of the country; to be awarded at the ensuing exhibition, to the makers of articles, in the opinion of the judges, deserving of the proposed rewards.

The premiums will be awarded by committees appointed by the Board of Managers, to decide on the merit of each branch of manufacture, or kind of goods; and their decision will be adhered to; the Managers of the Institute reserving to themselves the right of withholding any premium where the properties of the exhibited articles are not respectable.

Although the Institute is not in circumstances to offer premiums for so many interesting articles as might be desired, it will exercise the right of awarding compliments and rewards for such as are not specified in the list of premiums, where there exist distinguishing marks of superior usefulness, perfection in workmanship, beauty, or ingenuity.

To insure impartiality and inspire confidence, it has been determined that no committee shall award a premium to any of its members; and no Manager shall receive any premium or compliment.

It will be observed, that several premiums offered the last year for important objects, have now been omitted; but the Institute will renew the offer of them, whenever there appears to be a reasonable ground for expectation that they will be claimed.

Proof of origin will be required in all cases competing for premium. No premium will be given on account of any article that has obtained one at any other place, or from this Institute on a former occasion; or, that is of a quality inferior to what has already been before the Franklin Institute. Where the price forms one of the conditions of the premium, the makers must comply with the requisition, before they are entitled to the compliment.

Articles may be deposited at the Hall of the Franklin Institute, any time after the first of next August. Persons desiring further information, are invited to address themselves to any member of the committee on premiums, by letter, post paid, to which due attention will be given.

List of Premiums offered by the Franklin Institute of the State of Pennsylvania, and to be awarded at their third annual exhibition, in 1826.

1. To the maker of the best Cast Steel, manufactured in any state of the Union. A specimen of at least ten pounds, in bars of one half inch square, or smaller, must be exhibited; with a certificate, that at least one hundred pounds have been made. The quality of the steel, and the neatness of the bars, will be taken into consideration in estimating its merit.—A Silver Medal.

2. To the maker of the best specimen of Cast Iron Pipes, manufactured in the United States; samples not to be less than one hundred feet, of one inch caliber, in sections of at least four feet long; soft iron, and clean.—A Silver Medal.

3. To the maker of the best Smith's Anvil, steel faced, weighing not less than seventy pounds. The anvil made in any state of the Union.—A Silver Medal.

4. To the maker of the best specimen of soft iron castings fit for small machinery, to be cast free from sand and smooth; 50 lbs. to be exhibited.—A Silver Medal.

5. To the person who shall have made in Pennsylvania, the best rollers, suitable for the purposes of silversmiths.—A Silver Medal.

6. To the maker of the best Mill or Press Screw, of wrought iron, for the purposes of clothiers, printers, bookbinders, &c. not less than 2 5-8 inches in diameter, and of the usual length. It must perform its revolutions in the box without variation at the lower end, or pressing point. The box to be also of wrought iron.—A Silver Medal.

7. To the maker of the best and most perfect Scale Beam, for common purposes, superior to any now in use, capable of weighing at least twenty pounds; the beam made in the United States.—A Silver Medal.

8. To the maker of the best Instruments for operations on the Eye; the instruments to be made in Pennsylvania.—A Silver Medal.

9. To the maker of the best Table Knives and Forks, at least one dozen pair to be exhibited.—A Silver Medal.

10. To the maker of the best specimen of Sheet Brass; not less than twenty sheets must be exhibited.—A Silver Medal.

11. To the maker of the best Braziers' Copper, not less than twenty sheets to be exhibited, (thirty by sixty inches.)—A Silver Medal.

12. To the maker of the best raised Copper Bottoms, suitable for stills or boilers, not less than thirty inches in diameter.—A Silver Medal.

13. To the inventor of the best constructed grate, or stove, for burning anthracite.—A Silver Medal. The object of this premium is, chiefly, to obtain a grate suitable for domestic purposes, which will unite convenience with economy, and which may be used for cooking. Tastefulness of design, though not a primary object, will be considered, as far as it is compatible with economy. Certificates will be required of the Grate having been in use for some time, of the quantity of coal which it consumes, and of the effect which it produces.

14. To the inventor of the best constructed Furnace, for consuming anthracite in generating steam, to be applied to steam engines.—A Silver Medal. Certificates will be required of the furnace having been some time in use, of the quantity of coal consumed, and of the effect produced.

15. To the person who shall have manufactured in Pennsylvania, the greatest quantity of Iron from the ore, using no other fuel

but anthracite, during the year ending September 1, 1826. The quantity not to be less than twenty tons.—A Gold Medal.

16. To the maker of the greatest quantity of Glassware, not less than 100 lbs. The fuel used in the manufacture to be not less than 3-4 anthracite coal.—A Gold Medal.

17. To the maker of the best Flint Glassware; a variety of articles must be exhibited, and the excellence of their form, as well as the quality of the material, will be considered in awarding this premium.—A Silver Medal.

18. To the maker of the best Crucibles of earthenware, or other cheap material, suitable for brass founders. The crucibles must be able to resist heat, as well as those made of black lead; and to stand at least seven heats in a brass founder's furnace. They must be capable of holding at least forty pounds of metal: one dozen of crucibles must be exhibited, together with a certificate of their having been made in the United States.—A Silver Medal.

19. 20. 21. To the makers of the best pottery of Red and White Earthenware, from American materials. For each a Bronzed Medal.

22. For the best Glaze, made without lead, sufficiently cheap to be applied to common pottery.—A Silver Medal.

23. To the manufacturer of the best piece of Black Broad Cloth, made in the United States; not less than ten yards to be exhibited. A Silver Medal. Regard will be had to the quality of the dye, as well as of the cloth.

24. To the manufacturer of the best Flannel, made in Pennsylvania, not less than forty yards to be exhibited.—A Silver Medal. Assurance must be given, that three hundred yards at the stipulated price, will be furnished, if required.

25. To the manufacturer of the best Green Baize, made in the United States; not less than fifty yards to be exhibited.—A Bronzed Medal.

26. To the maker of the best Woolen Blankets, made in the United States; one dozen pair to be exhibited.—A Silver Medal. The blankets to be from two to four points: regard will be had to the weight, and no premium awarded, unless the quality be equal to the imported article.

27. To the maker of the best specimen of Ingrain Carpeting.—A Silver Medal. A piece of not less than twenty yards to be exhibited, with a certificate of its having been made in the United States.

28. To the maker, in Pennsylvania, of the best Worsted Stockings, not less than one dozen pair to be exhibited. The price will be considered.—A Silver Medal. Five dozen pair to be furnished at the same price, if required.

29. To the manufacturer, in Pennsylvania, of the best Loom Cotton Stockings—Not less than one dozen pair to be exhibited.—A Silver Medal.

30. To the manufacturer of the best specimen of Furniture Calicoes, (Chintzes) made in the United States; not less than fifty yards to be exhibited.—A Silver Medal.

31. To the manufacturer of the best specimens of Calicoes, or Prints, for ladies' dresses, made in the United States; not less than fifty yards to be exhibited.—A Silver Medal.

32. To the manufacturer of the best specimen of Salempore, manufactured in the United States, in imitation of that imported; not less than ten pieces to be exhibited.—A Silver Medal. In estimating this article, its colour, as well as texture, will be considered.

33. To the manufacturer of the best Cotton Ticking, made in the United States.—A Silver Medal.

34. To the manufacturer of the best Cotton Cloths, of superfine quality, in imitation of English Cambric Muslin.—A Silver Medal.

35. To the person who shall have produced in Pennsylvania, and reeled, during the year ending October 1, 1826, the greatest quantity of Raw Silk, not less than ten pounds.—A Silver Medal.

36. To the maker of the best specimen of Morocco, made in the United States, not less than twelve pieces of each colour, to be exhibited.—A Bronzed Medal.

37. For the best specimen of Skirting Leather, tanned and dressed in Pennsylvania—twenty sides to be exhibited.—A Silver Medal.

38. For the best specimen of Hog Skins, dressed in Pennsylvania —two dozen skins to be exhibited.—A Silver Medal.

39. For the best set of Gig, or Coach Harness, made in Pennsylvania.—A Silver Medal.

40. To the maker of the best Buckskin Gloves, the leather dressed in the United States, the Gloves made in Pennsylvania—not less than a dozen pair to be exhibited.—A Bronzed Medal.

41. To the maker of the best Kid, or Sheep skin Gloves, the leather dressed in the United States, the Gloves made in Pennsylvania—not less than a dozen pair to be exhibited.—A Bronzed Medal.

42. To the manufacturer of the best Japanned Leather, prepared in the United States.—A Bronzed Medal.

43. To the maker of the best Cabinet Secretary, and Book-case. —A Silver Medal.

44. To the maker of the best Pier Table.—A Silver Medal.

45. To the maker of the best Mahogany Chairs and Sofa.—A Silver Medal.—One dozen Chairs to be exhibited. Regard will be had, in awarding the premium on Cabinet ware, to the taste exhibited in the design, as well as to excellence in workmanship.

46. For the best Beaver Hat, price $9.—A Silver Medal.

47. For the best Fur Hat, price $4.—A Silver Medal.

Assurance must be given by every competitor, that he will furnish 500 hats, equal in quality, and at the price named, if required.

48. To the maker of a Hydrant, that shall be adjudged superior in principle, to any now in use.—A Silver Medal.

49. To the person in the United States, who shall have invented an apparatus practically superior to any now in use, for heaving up a Ship's Anchor.—A Silver Medal.

50. To the person who shall indicate to the Institute, a method

better than any in use, to protect timber in ships, or other works, against the effects of the dry rot. The process must be such as can be applied on a large scale, without too great an expense.—A Silver Medal.

51. To the Individual, or Company, in Pennsylvania, who shall construct a Marine Railway, for hauling ships out of the water for repair, or other purposes—the same to be completed within one year.—A Silver Medal.

52. To the person who shall have made in Pennsylvania, the greatest quantity of Oil, from any vegetable raised in this State.—A Silver Medal. The oil must be of a quality suitable to be used as a substitute for Florence or Olive Oil—the quantity obtained, not to be less than twenty gallons.

53. To the person who shall cultivate the greatest quantity of Madder—the produce of not less than a quarter of an acre. Samples must be exhibited, with a Certificate of the quantity produced. —A Silver Medal.

54. To the *person* in Pennsylvania, who, from the 1st of January, to the 1st of September, 1826, shall have plaited the greatest length of Straw or Grass Plat, suitable for Bonnets.--A Silver Medal.

55. To the *family* in Pennsylvania, which has plaited the greatest length of Straw or Grass Plat, suitable for Bonnets, from the 1st of January, to the 1st of September, 1826.—A Silver Medal.

56. To the *person* in Pennsylvania, who has made the greatest number of Straw, or Grass Bonnets, from the 1st of January, to the 1st of September, 1826.—A Silver Medal.

57. To the *family* in Pennsylvania which has made the greatest number of Straw, or Grass Bonnets, from the 1st of January, to the 1st of September, 1826.—A Silver Medal.

58. To the manufacturer of the best White Lead—50 lbs. to be exhibited.—A Silver Medal. Assurance must be given that 20 tons will be furnished of the same quality, at the same price.

59. For the best specimen of Lithography, to be executed in the United States.—A Silver Medal.

60. To the person who shall discover, and indicate, any substitute for Printers' Ink, which shall be superior to the present composition. —A Silver Medal.

61. To the maker of the best pair of Marble Mantles, of Pennsylvania Marble—the design, as well as execution of the work, will be considered.—A Silver Medal.

Pennsylvania Society for the promotion of Internal Improvements in the Commonwealth.

By referring to the prospectus, it will be seen that the transactions of the above Society, will all pass through the hands of the Editor of this Journal. The object of this association, independently of its direct tendency to give employment to a great number of Mechanics, is so intimately connected with the general prosper-

ity of the state, as to address itself, most powerfully, to the interest, and to the patriotism, of every class in the community. The benefits which have already accrued from the efforts of this association, are evinced by that spirit of enquiry, which has been excited on the subject of Internal Improvement, and by the general conviction that it is requisite the business should be promptly commenced, and actively pursued. It has brought together a number of intelligent, patriotic, and influential individuals residing in different parts of the commonwealth, who, although they felt the importance of the subject, were, in many instances, unknown to each other, and were without the means of co-operation.

An active investigation is now in progress, to ascertain the most eligible routes, and the most effective means for facilitating intercourse throughout the state, "by opening an entire and complete communication from the Susquehanna, to the Alleghany and Ohio; and from the Alleghany to Lake Erie."

An effort more truly patriotic has rarely been made. The members of this society have devoted their time, and their wealth, to the attainment of objects, in which they have no interest whatever, that is not possessed in common by every individual in the community. The association was organized in December, 1824; the number of members is forty-eight; each of whom subscribed one hundred dollars, to form a fund for the immediate promotion of the objects in view; and the further sum of ten dollars, annually. It is now proposed to make a new organization of the society; so as to obtain the assistance of the numerous friends of Internal Improvement, who, although they might find it inconvenient to subscribe as largely as the first members, would yet gladly lend their aid, by becoming annual contributors.

It is not contemplated to publish *in extenso*, all the transactions of this Society; but to give such an abstract of them, as shall be calculated to make its views, and proceedings, generally known.

The following extracts from the "First Annual Report of the Acting Committee," will be found highly interesting.

Extract from the First Annual Report of the Acting Committee of "The Pennsylvania Society for the promotion of Internal Improvements in the Commonwealth."

"As soon as the Society was organized, and its officers appointed, the Acting Committee entered on a vigorous and industrious prosecution of the duties assigned to it, and of the plans which appeared to the Committee best calculated to further the purposes of the Institution; the promotion of Internal Improvements in the Commonwealth.

"The most friendly feelings, and most favourable dispositions are entertained towards the Society, in all parts of the state; and although the number of its members has not been augmented, an active, unremitting, and widely beneficial co-operation in all the views of the Society, has been every where manifested.

"As means of spreading information on Internal Improvements,

and to promote sound opinions in relation to them, the Acting Committee have, since their organization, published, and circulated through the state, a variety of papers upon *Turnpike Roads*, *Canals* and *Railways*.

"On the 19th of January, 1825, the Society resolved, 'That it is expedient to send an agent to Europe, to collect information of all the valuable improvements in the construction of Canals, Roads, Railways, Bridges, Steam-Engines, and all other information calculated to promote the objects of the Society."

"Upon the 3d day of February, 1825, the Society appointed William Strickland, Esq. their agent in Europe; assigned to him an adequate compensation, and determined upon the period of his departure.

"Upon the Acting Committee, devolved the important and responsible duty, of preparing the instructions of Mr. Strickland. The judicious selection of a gentleman for this mission, of whose competency every one had the fullest belief, and who enjoyed the confidence and respect of the community, rendered this duty less difficult than it would otherwise have been; and the Committee received from Mr. Strickland, every assistance in its performance.

"After every effort had been made to invite and collect proper materials, the instructions of Mr. Strickland were prepared, and submitted to the Society, and upon the 17th day of March, 1825, they were approved, and ordered to be signed by the President of the Society, and by the Acting Committee. A copy of these instructions accompany, and are deemed a necessary part of, this report.

"At the same meeting of the Society, one hundred pounds sterling, were ordered to be placed in the hands of Mr. Strickland, "for obtaining correct information relative to the smelting of iron;" and an equal sum was directed to be employed by him, "in the purchase of memoirs, publications, models and drawings of useful machines, and authentic information on all subjects, a knowledge of which, in this country, he might deem important." The Society had, at a previous meeting, resolved to contribute to the expenses of Mr. Samuel Kneass, a young gentleman of considerable talents and promise, the pupil of Mr. Strickland, who was to accompany him in his visit to Europe, and whose assistance was considered by the Society, beneficial to the objects of the mission of his instructer.

"Mr. Strickland, and Mr. Kneass, sailed from Philadelphia for Liverpool, on the 20th of March, 1825.

"The Committee now enter upon the most pleasing of their duties, in recording the proceedings of the agent of the Society, during his absence in Europe, on the trust assigned him. A liberal and enlightened citizen, has recently declared this mission to be "a more important embassy, than any we (the nation) support in Europe." The Society and our country, we believe, will, at no distant day, find this high commendation justified by the benefits

the community will derive from the efficient labours of Mr. Strickland.

"Immediately upon his landing, Mr. Strickland entered upon the duties with which he was charged; and during the whole period of his absence, his diligence and industry, and untired activity, were exclusively dedicated to the collection of the information, and the accomplishment of the objects, to which he was pledged.

"It is a just tribute, and one which is rendered with peculiar satisfaction to those who are so well entitled to it, to state to the Society, that from every gentleman of science, and attainments in those branches of knowledge and the arts, which are particularly connected with civil engineering, Mr. Strickland received the most liberal and extensive assistance. The bureaus of the British Engineers of the first rank and acknowledged usefulness, the cabinets of men of science in England, Ireland, and Scotland, were freely thrown open to him; and all they had acquired by diligent study and experiment, all they had done in the erection of the great works which are the just and merited pride of those countries, and the principal sources of their wealth and prosperity, were placed at his disposal. Science and philosophy, and the liberal arts, are usually found in the possession of men of enlarged and expanded views, and of the most generous purposes. It is one of the best effects of knowledge and intelligence, that they liberalize the heart, and unshackle it from the influence and power of prejudice, and from the bonds of local interests. The best and the most pleasing testimony of the truth of these principles, has been exhibited in the conduct of the Engineers of England, Scotland, and Ireland, to Mr. Strickland.

"The first subjects to which the Agent of the Society was directed to give his attention, was the construction, and use, and expense of *railways*.

"In the prosecution of these investigations, and to test by actual examination and observation, the principles and statements of the friends, and of the opponents of railways, Mr. Strickland visited England, Scotland, and Wales; and in August, the Society received his report, dated June 5, 1825, containing the information he had collected, accompanied with plans and drawings of railways, of almost every form then in use, or in contemplation, in England and Scotland.

"So comprehensive, so particular, and so full is the report of Mr. Strickland upon the construction, use, and expense of railways, and of the machinery employed upon them, that all which may be required for their introduction in our country, or to manifest and establish their competency for the purpose to which they are applicable, will be found in his report. By the acquisition of this knowledge of railways, which has been the consequence of the mission of Mr. Strickland, it is now as much in the power of our state, or of any individual or corporation, to erect and adopt a railway of the best, or of any form of construction, as it would be, were *Wood*, and *Jessup*, and *Rennie*, and *Telford*, and *Tredgold*, to become resident citizens of the Commonwealth of Pennsylvania.

A working model of a loco-motive engine, on the most approved plan, and having a power equal to the strength of two men, was procured by Mr. Strickland, and is in the possession of the Society. A machine so valuable, and of such astonishing competency for the purposes to which it may be applied, ought to be more generally known in our country.

"The next report received from Mr. Strickland, was dated the 16th of June, 1825, which, as far as its contents are connected with *railways*, may be considered as *a supplement* to the *first report.* It contains "*a description of the Duke of Portland's tram-road,*" and a very particular and interesting account of the mode of *coking bituminous coal,* and of *making cast and blister steel.* The drawings which accompany, and form a part of this report, exhibit, in detail, the processes which are in successful use in England, for the production and manufacture of the articles mentioned.

"The report of the agent, upon *Turnpike-roads,* is dated August 3, 1825. The matter contained in this report is of the most interesting kind; and it furnishes facts, and suggestions for their advantageous use in the construction of roads, which, if employed, will be of the most extended usefulness.

"The whole method of Mr. M'Adam for improving roads, and the principles so successfully applied to them, are fully shown in this report. The plan upon which "the great government road from Hollyhead to London," is made, which Mr. Strickland pronounces "one of the smoothest and best in England," is particularly described in it. This road is the work of *Mr. Telford.*

"Mr. Strickland has furnished, in reference to the manufacture of iron, much valuable information; and his plans and elevations of the most approved furnaces for the smelting of iron, ought to obtain the attention of the iron masters of our state.

"Upon *Oil* and *Coal Gas,* useful knowledge is communicated; and the introduction of gas into our city, or its employment for lighting extensive manufactories, may be secured by the use of the materials exhibited in this report.

"The last information, in the form of a report, which was received from Mr. Strickland, is dated at London, on the 4th September, 1825. This report is "*Upon Canals.*"

"Upon all the most important subjects connected with the construction of a canal, upon the most approved methods of forming and using locks and embankments, upon the best modes of building aqueducts and culverts, and of forming tunnels, and upon the most valuable and successful arts of securing such works from accidents and injury, the information contained in this report of the agent of the Society, appears abundant, and all-sufficient. With this, as with all of his communications, are transmitted drafts and plans, and sections, and drawings of all the parts, and details of the works of which the report treats. These, like the working models of a skilful architect, will enable any one, properly prepared by study and experience in the science of civil engineering, to ap-

GENERAL VIEW OF THE HETTON RAIL-WAY, LEADING FROM THE COAL MINES TO THE TOWN OF SUNDERLAND.

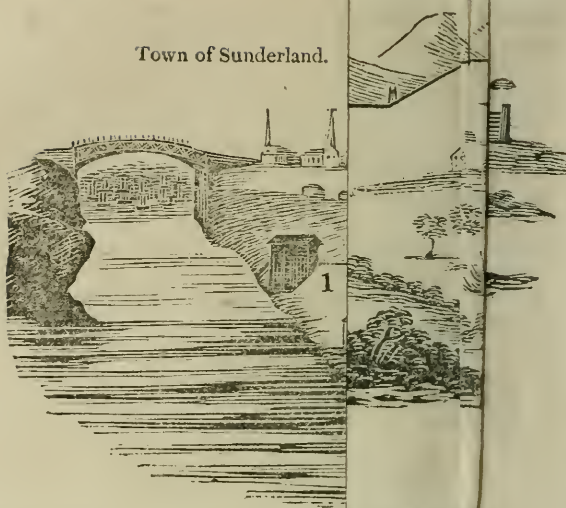
1. Staith—2. Fixed Engine—3. Fixed Engine—4. Pit.——Whole length of the road, 7 miles and 5 furlongs. The elevation and depression overcome, 812 feet.

Locomotive Engine, 12 horse power; weight 5 tons. Cost in England, £600. | Tender with coals & water.

The train consists of 24 Chalder wagons, containing 90 tons.

GE THE OA

Town of Sunderland.



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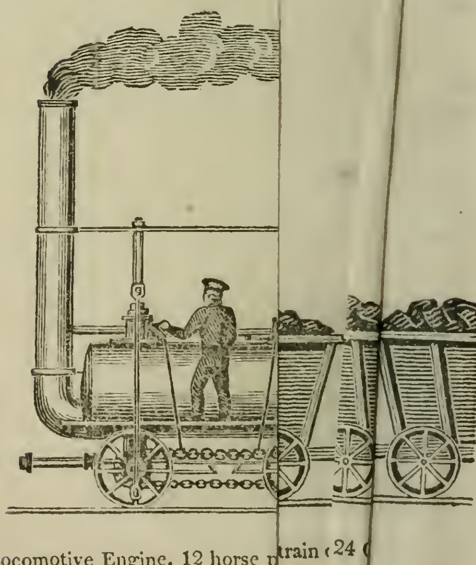


Locomotive Engine, 12 horse p train (24
weight 5 tons. Cost in En
£600.

ply the information communicated in the report, to immediate use and advantage.

"Having, as he believed, accomplished the objects of his appointment, and desirous of returning home at a period when the knowledge he had attained, might be employed for the promotion of the great purposes of the Society, he left England, and arrived in Philadelphia in December.

"Mr. Strickland is now engaged in a final report to the Society, in which he will no doubt communicate much important information, upon all the subjects which had his attention when absent.

"Subjoined to this communication is an acurate list of the publications and manuscripts, received from Mr. Strickland during his absence."

Signed by Mathew Carey, Richard Peters, Jun. William Lehman, Joseph Hemphill, Stephen Duncan—Gerard Ralston, Corresponding Secretary.

Philadelphia, Jan. 4, 1826.

An abstract of the instructions given to Mr. Strickland, shall appear in the next number.

FOR THE FRANKLIN JOURNAL.

A description of the Hetton Rail Road, in England; by Wm. Strickland, Esq. Civil Engineer. (With an Engraving.)

The Hetton Rail-road, extends from the town of Sunderland, on the River Weir, to the Hetton Collieries. Its length from the pit to the staith, is seven miles five furlongs; it has an *ascent* of two hundred and sixty-six feet; and a series of *descents*, equal to five hundred and forty-six feet; making, in the whole, 812 feet of elevation and depression, overcome by a series of *levels* and *inclined planes*. The first portion of the road, from the pit to the foot of the ascending plane, is one mile seven and a half furlongs in length; and its general descent is one-ninth of an inch to the yard, (with a portion of it, five-sixteenths) which is equally favourable for loaden and light carriages. A single loco-motive engine, with twenty-four wagons in train, has drawn six hundred tons per day, going nine *gaits*, equal to thirty-five miles forwards, and returning.

On another portion of the way, in length two and a half miles and sixty yards, with a descent, for the greater part, between four and five-sixteenths of an inch to the yard, on which the loaden wagons tend to move of themselves, and consequently produce less stress on the light train, two loco-motive engines, in use at the same time, have conveyed the quantity above-mentioned.

Stationary *reciprocating engines*, are placed at the summits of the inclined planes. These engines draw loaden, and light wagons, alternately each way; and each successive station performs its operation in the same time; the relative speed of the wagons, being according to the distances between the Engines, so that their respective journies may be completed in similar times, and main-

tain a uniform succession of carriages each way, by means of ropes, alternately winding and unwinding upon drum wheels, eight feet in diameter.

On one of the inclined planes, the ropes are upwards of two miles in length, being supported by light cast iron concave rollers, fixed at a distance of forty or fifty feet apart, in the centre of the way, between the rails; and as the ropes are *wound on* and *off* the drum, the small rollers revolve, and keep them from coming in contact with the soil of the road.

Where the road-way deviates from a straight line, *in plan*, or where the *plane* winds to the *right* or *left*, the axes of the rollers are placed in nearly a vertical direction; in order to keep the line of draught midway between the rails.

It will be perceived by the engraved view, that this road is formed over an undulating, or hilly country; and that the transportation of all the articles from the collieries and its neighbourhood, is made to surmount a series of very considerable ascents, by means of fixed engines, placed on their summits; and the motion given by these machines to the wagons reciprocally, is equal to nine miles an hour.

The rails are made of cast iron, four feet in length; and are known generally, by the denomination of the edge, or round top rail, of Losh & Stephenson.

The loco-motive engines are made of thick sheet iron, and are obviously of the high-pressure kind; they are only made to ply upon *level lines of road;* for the engine itself, in any material ascent, consumes a great portion of its power in the movement of its own weight, and that of its fuel; and any sudden rise would annihilate its object and use.

NATURAL HISTORY.*

Few departments of knowledge, have been more injured by incorrect or prejudiced views of their real character, than Natural History; which some regard as a mere collection of tales for the amusement of children, or idlers; and others, as an aggregation of learned lumber, too heavy for use, and too harsh to be interesting. That such notions are not altogether unwarranted by those who have been called Naturalists, is too true; many of their books being filled with the most incredible nonsense, while a very large number of those claiming to rank as purely scientific, are little better than Dictionaries, in which the authors have tasked their ingenuity, to accumulate all the harsh and barbarous terms they could compound from various living and dead languages. Yet granting thus much, by no means renders it fair to argue against the usefulness of Natural History, from the abuses which have been cloaked under

* Dr. Godman, professor of Natural History in the Institute, has engaged to become a contributor to, and to aid the Editor in conducting this department of the Journal.

its name; a similar mode of reasoning, might lead to the rejection of the most admirable and valuable institutions, since we cannot find one, however excellent, which has not in some degree been abused.

Another prejudice which has tended to retard the diffusion of a proper knowledge of Natural History, is the idea that a great deal of *learning* is necessary to beginners of this study. Hence, many excellent opportunities have been entirely lost of observing and establishing facts, concerning which the world may long remain in doubt; those who have enjoyed such opportunities, have supposed it necessary that they should be very learned, before they would have a right to announce what they had seen. It is most true that preliminary education is of great advantage in all Sciences and Arts; but in Natural History, which is almost exclusively a science of observation, a close attention to facts seen, and an accurate relation of them as they occur, are of more value than the most learned discussion, and would be certainly far more acceptable, than the highest refinements of speculation. All the learning that is necessary for any one to become *practically* (which is, *usefully*) acquainted with Natural History, is a sufficient degree of intellectual cultivation, to save him from seeing incorrectly, or mistaking secondary, for the primary, and really important circumstances. For instance, it was long supposed by observers, that the *Skunk* (or Pole-cat, as it is popularly called,) diffused its powerfully offensive odour by sprinkling a fluid on its disturbers with its bushy tail; and this silly notion has been repeated until very recently, even by grave authors. More accurate observation has shown that the animal raises the tail suddenly, *previous* to the diffusion of the offensive liquor; and in order to prevent this substance from touching it, being peculiarly clean and neat in its own person. Various analogous cases may occur, in which incorrect conclusions might be drawn, without some preparatory knowledge; but with the proper care in making observations, or stating the actual condition of facts, even incorrect conclusions, will be comparatively harmless.

Every man of ordinary capacity, may study Natural History for himself, and advantageously too, if he be really desirous to form an acquaintance with *Nature* through her works, rather than to shine as a framer of systems, or a composer of theories. To study Natural History, it is only necessary for us to use our eyesight—to look upon the multitudes of living beings by which we are surrounded, observe their peculiar construction and adaptation to the places they occupy, their modes of living, and the relations they bear to other animals, and to man himself: this is the study of *Natural History*. The fruitless and wearying discussion of technical phrases, or the propriety of various classico-barbarous appellations, with hair splitting distinctions of genera, sub-genera, species and varieties, is NOT Natural History, but the study of *Nomenclature;* a dry and barren waste! tenanted only by fierce and fruitless jealousies, recriminations and disquiets of every degree!

The study of Natural History is too beneficial in its influence, to allow of its being restricted to the few who are able to approach it through the severe and uninviting method of arbitrary and artificial classification. As its immediate tendency is to enlighten the mind, and warm the heart; to enlarge our feelings of respect for our own race, and enable us more correctly to appreciate the beneficent wisdom of the Creator, we believe that those writers who endeavour to render Natural History generally accessible, confer more benefit on mankind, than if they filled whole libraries with books of the *deepest* learning, too abstruse to be generally read; therefore but seldom approached, and still more seldom understood.

The difference between *learning*, and *wisdom*, is never more clearly perceived, than when we observe the conduct of those who mistake *Classification* and *Nomenclature*, for Natural History; and violently object to every effort made to diffuse knowledge, without the shackles they have imposed on themselves. Many such men are truly and deeply *learned*, but they certainly are not *wise*, when they forget that classifying, and naming, are only among the *means* of acquiring knowledge, and are not the *end* we have in view; that scientific arrangements are mere *instruments* to work withal; that systems at best serve the purpose of an index; that they are arbitrary and mutable; always the productions of Art, and seldom having much affinity with Nature.

Nevertheless, a good machine to work with, is extremely desirable; and the best system we can find, is an excellent aid in the study of Natural Objects, provided we never once forget, that the *system* at best is but a *tool* with which we are to accomplish a very important work, the collection and arrangement of useful knowledge. Such a system, as far as utility is concerned, has been formed by George Cuvier, (better, and more emphatically known as Cuvier,) founded on characters furnished by the Anatomy of Animals. Their rank in the scale, is determined by their degree of approach to the construction of the human body; and their relations to each other, determined by their peculiar regimen or modes of life, and organs of digestion—as indicated by the subsidiary apparatus for the seizure, and mastication of their food.

Our object in thus endeavouring to invite more general attention to this delightful study, is to open a new and most ample source of gratification to many, who have both leisure and opportunities for observation, but are withheld by mistaken notions. There is in fact, a vast deal yet to be observed, before the Natural History, of even our most common animals, can be completed; and every actual observation, will be of the highest value. Independent of this, as a source of individual gratification, it is not to be excelled; seeing that the objects of nature are boundless, and the field is open to all. It is not in books that we are to find nature; though they may aid us in planning our walks, or in guiding our observations: but it is in the fields and woods, in the plain, and on the mountain, by the side of the rippling brook, or on the sandy beach lashed by ocean's foaming waters, that the student must look, with

the fullest certainty, of finding objects capable of rewarding his search; and opening his eyes to perceive, that the works of the Creator, are best to be understood when read from that great book which is accessible to all, and is *unobscured* by gloss or commentary.

TH.

Remarks on an Article in the North American Review.

The last number of the North American Review, (50th) contains a criticism on a work published sometime since in this city, entitled "Fauna Americana." This article contains many judicious and useful remarks, written in a candid and manly style; yet to judge merely from the review itself, one might infer that the writer was not technically familiar with the subject before him; and although he has given numerous proofs of discrimination and judgment, does not *appear* fully to understand the actual condition, "the form and pressure" of scientific Natural History, as it now exists. We say he *appears* to be in this condition, for we have no mode of judging of his standing, except through the review before us. The impression we have received from reading this criticism is, that it is written by one accustomed to close thinking and sound logic; but not practically and technically, a Naturalist; to whom the glaring faults of the book have been pointed out by one familiar with the subject, but in a desultory manner; in short, by a person who is an admirer of Natural History, but not a closely applied, or profound student of the science. Such is our impression; though we well know how easy it is to be mistaken.

The writer of the review, has truly found a very sufficient number of faults in the "Fauna," but a *technical* critic would have attributed these faults to M. Desmarest in very great part, and not to the American "Author;" since, out of three hundred and fourteen pages, very nearly, if not quite, *two hundred* and *fifty* are verbally and literally translated from the "*Mammalogie*" of the French Naturalist. This a *technical* critic ought to have known. The faults for which the American Author is really responsible, (although he did actually assume the others,) are those parts which are considered as peculiarly *original*, in the "Fauna;" and these are certainly not few. Except these *original* errors, the whole of the rest should be charged to *Desmarest;* he it is, who should be scolded for not introducing the extracts from Bonnaterre's "*Cetologie*," as it is he, who quoted this writer. We believe that the author of the "Fauna" never saw that work; nay, we are almost sure it has not yet reached America.

A technical critic would have known better than to elevate to the rank of an *original* work, such a one as the "Fauna," under whatever guise it might be presented to the world. A reviewer is, with no great impropriety, supposed to know all things relative to the subject on which he writes; or, in other words, the publication of a review, presupposes that the writer has taken pains to acquire

all necessary information. Had this been the case in the present instance, the reviewer would have saved much trouble by stating the plagiarism above indicated; as well as done more ample justice to the science and literature of his own country.

The best part of the review, is that in which it alludes to the confused classification in the "Fauna;" and the want of dignity exhibited, in bringing personal squabbles, into systematic works. The observations on fossil animals, the distinction of genera and species, and on Cuvier, is the weakest part, as well as the least applicable to the matter in hand. Of the actual faults of the "Fauna," or what we have called the *original* errors, the reviewer has seen and felt (for no technical Naturalist can avoid feeling as well as seeing them,) but few; and these inaccurately, though he has stated in general terms, that there were too many to be pointed out individually. That the "Author" is competently acquainted with Natural History, the reviewer admits from the evidence before him—this no Naturalist can possibly conclude from the *book*, though we know it to be so, *in fact.* The *book* displays extraordinary ignorance of the first principles of the science; as in the formation of *species* from variations in dental formulæ; when if any thing were done, it should have been to form a new genus or sub-genus. A technical critic would not have passed over so slightly, the formation of a new genus of *extinct* quadrupeds, from a *recent* skull found on the banks of the Delaware; not a "mutilated" one, as the reviewer supposes, but the skull of an animal thrown overboard from some vessel, which probably had been bringing the animal alive, to Peale's Museum. This is a good specimen of the skull of a well known genus; the Paca of South America, established under the title of Cœlogenus by F. Cuvier in 1810, and accurately figured in the Annals of the French Museum,* of which several copies have long been in Philadelphia. It is moreover described in all the systematic books, and its dental system is accurately figured in the "Dents des Mammiféres" frequently quoted by the "Fauna:" even in Desmarest, there is a full account of it. This skull, the author of the "Fauna" compares with the first animal in the order, the beaver; instead of discovering by its structure, how much more nearly it is approached by various other genera, which in fact are but slightly removed from it. Were the author judged by his *book* alone, his claims to consideration as a scientific Naturalist, would be reduced to rather worse than nothing.

The great error of the author of the "Fauna," consisted in translating,† and being in haste; had he relied on his own resources, and exerted his own industry, for which he is laudably conspicuous, he would have made a better book, and been far more useful in his day and generation. As it is, his book has fallen "dead born" from the Press; and until eventually engulphed in that oblivion, to

* This "original" error was first pointed out by T. Say.

† It is but just to state, that he acknowledges having translated "the *descriptions* of about fifty" *species,* though he is silent concerning all the rest.

which its peculiar character is rapidly hurrying it, will serve as a beacon to future adventurers on the same perilous seas.

On another occasion, it will give us much pleasure to consider some of the propositions advanced by the reviewer, to whom we are indebted for the article in the North American. Whether *technical* or not, we flatter ourselves we could convince him of some inaccurate conclusions, into which he has been led during the course of his well written paper, considering it for the present, rather as an essay on the principles of classification, than as a criticism on a particular book: at the same time, we freely confess, that we shall be happy to receive, at all times, the observations of so well exercised, and judicious a mind. X.

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. I.

To the Mechanics and Manufacturers of Pennsylvania.

My Friends,

There is scarcely an individual of you, so entirely unacquainted with the code of laws of this Commonwealth, as to be ignorant of the immense extent of matter that it contains. With its boundaries you are perhaps not familiar; but most of you, know that it ranges over a very wide field. This extension is owing, in some measure, to its origin. When the people of these United States dissolved our *political* union with Great Britain, in 1776, Pennsylvania did not reject her laws. Our forefathers passed an Act of Assembly, which declares that each, and every one of the laws and Acts of Assembly that were in force in the previous province on the 14th day of May next preceding, should be binding on the inhabitants of this State, from, and after the 10th of February 1777, as fully and effectually to all intents and purposes, as if the said laws, and each of them, had been made and enacted by that Assembly. By this general and sweeping clause, all the laws of England which were in force in this Commonwealth before the Revolution, were adopted; except some particularly excepted in the Act, and which it is not necessary here to notice. This suggests the enquiry, what English laws were in force in Pennsylvania, on the 14th May 1776?

They consisted,

1st, Of the Law of Nations; which is a part of the Law of England, and has always formed a part of the Municipal Law of Pennsylvania.

2ndly, The Common Law of England.

3dly, Acts of Parliament made in England, previously to the settlement of Pennsylvania; and extended here by either Acts of Assembly, Adjudications of our Courts, or established usage.

4thly, Acts of Parliament, made between the time of the settlement of the Province, and that of the Revolution; in which Acts

the Province is especially named; extended in like manner as the Acts last before noticed.

The Common Law of England, being, as you perceive, a part of that system by which our daily actions are tested, is to be sought for in the Adjudications, to be found in the English Books of Reports; which, without calculating those reported since the Revolution, (the Legislature of Pennsylvania having excluded those from our courts,) amount to several hundred volumes. Some of them are written in Latin, and some others in a barbarous jargon, denominated Norman French.

In the year 1809, the Judges of the Supreme Court, by virtue of a resolution of the Legislature, made a report of the English Statutes in force in Pennsylvania. They amount to nearly one hundred, and are scattered over ten large quarto volumes.

To these, may be added seven volumes of Acts of Assembly, and upwards of thirty volumes of reports of decisions of the Courts of our *own State;* not to mention the numerous volumes of reports of decisions in our *sister States;* which, although they have no binding force on our courts, are daily read, and more or less influence their decisions.

Besides these, there are English and American abridgments, digests, elementary tracts and annotations, so numerous, that their very names have become a burthen to the memory.

The enumeration of these sources from which our laws are derived, will not, it is hoped, appal the scientific student; he must be content to devote years to the acquirement of a knowledge of its first principles; but it will at least convince the industrious operative Mechanic or Manufacturer, that any attempt on his part to make himself master of the whole science, will be vain and fruitless. Yet, strange as it may seem to you, with this mass of information you are *presumed* to be acquainted; and an ignorance of its principles, is not allowed as any excuse for your actions or omissions. *Ignorantia legis non excusat*, is a well known maxim of law.

This state of Jurisprudence has given rise to various speculations, and many plans have been from time to time proposed to obviate the evil. Some have wasted their time in venting vain regrets that our laws were not more simple; as if simplicity of legislation, was at all consistent with our state and condition. A few simple maxims are sufficient for a people living in a rude state, claiming no other title to the soil than actual possession, with few domestic relations, few Manufactures and Arts, and enjoying no commercial intercourse with other nations. But as soon as Society becomes refined, titles become complicated, domestic relations encrease, Manufactures and the Arts begin to flourish, and the laws must necessarily be multiplied: and no nation can participate advantageously in the commerce of the world, unles it adopts and conforms to a regular commercial code.

There is another, and a higher consideration, which ought to reconcile us to the evils arising out of a multiplicity of laws, which

is, that they bear an exact ratio to the liberty of the citizen. Under a government where the uncontrolled will of the sovereign is the rule of action, where the legislative and judicial powers are concentrated in one person, they may boast of the simplicity of the laws: but in a country like this, where all power is inherent in the whole body of the people; where life, liberty, reputation and property, are safely entrenched behind constitutional, legislative and judicial fortifications: where no rule is made without the deliberate expression of public opinion, through legally authorized representatives, and where no right can be restricted, or privilege interfered with, without a cautious examination, and impartial decision, it is impossible that the laws should be either few, or simple. The inconvenience we suffer by a multiplicity of laws, is the *low* price we pay for the inestimable blessings of liberty and independence.

In some of our sister States, it has been thought expedient to collect, digest, and analyze the laws; and by those means to condense them into a moderate compass. This is a work worthy of our imitation, but it is an herculean task, which, whenever it shall be done, by order of the legislature, will require the aid of much talent, time, and perseverance. Mr. Viner's abridgment of the laws of England, occupied that gentleman ten years, and fills twenty-four octavo volumes.

In the interim, if a citizen has any thing to offer by way of melioration, it is his right, if not his duty to suggest it.

It is impossible to make our fellow citizens acquainted with all the laws of the Commonwealth, my plan therefore, is to instruct each class in those laws with which it is most intimately concerned. To the Physician it is more immediately necessary to be acquainted with the law relating to Homicide, Births, Lunacy, Testaments, &c. &c. These laws have been collected together, digested and arranged, and form a system which has been entitled *Medical Jurisprudence.*

To the Mechanic, and Manufacturer, it is important to know the law relating to patent rights, Mechanics' Liens, Master and Apprentice, to keeping books so as to make them evidence in Courts of Justice, &c. &c. If these were collected together, properly pruned and digested, they would form a system which might be dignified with the appellation of MECHANICAL JURISPRUDENCE. It appears to me that there can be no doubt, either of the practicability, or utility of the measure. I hope to hear no objection, arising out of the professions of those whom I would endeavour to instruct. Is there any more reason for withholding from the Mechanic or Manufacturer the knowledge of so much of the law as is absolutely necessary to enable him to carry on his business with advantage, and to preserve him from litigation, than there would be in denying to the lawyer so much of mechanical knowledge as would enable him to build or repair his house cheapest or with the best materials? If there be any such reason, I confess that it is beyond my comprehension.

There are some who will endeavour to throw ridicule, upon what they cannot refute by argumentation. These will laugh at the idea of my "converting every man into his own lawyer," as they will term it: but the candid and reflecting will perceive that I am making no such attempt. All that I propose to do with the law, is to place it on the same footing with the other sciences. The learned and respected professor of Chymistry who is now lecturing in the Franklin Institute Hall, to a class of Mechanics, does not indulge the hope of making them scientific Chymists; but he does expect to teach them that part of the Science of Chymistry, which is connected with the Arts. In like manner I would teach you the law that is intimately connected with your respective trades and business. The object of these essays is not to enable a Mechanic to *carry on* a law suit, but to *avoid* one. It is not professed to teach you the refinement of special pleading, but to render the plea unnecessary. It is not desired to make you lawyers, but to preserve you from litigation. It is *prevention*, not *cure*, that I have in view.

It was with a desire to ascertain whether this plan was practicable; and if it was, whether it was expedient to put it in execution, that I have within the two last seasons delivered before the Franklin Institute, some lectures upon legal subjects, and with the same ends in view, I shall write a few essays for the Journal. I am sensible that these essays, written amidst the commotions of an active, professional life, will be very imperfect; but as I claim no extraordinary merit, so I offer no unnecessary apology.

I shall commence in the next number, with the law of *Mechanics' Liens.* P. A. B.

BORING FOR WATER.

The subject of boring for water, is one that excites a large portion of interest in various parts of the United States, as well as in England; from the Journals of the latter country, the following articles have been selected; and it is the design of the Editor, in a future number, to insert a description of several implements for which a patent has been obtained, by an Engineer who has been extensively and successfully employed in this business. Persons possessed of information respecting the result of similar efforts made in the United States, or any improvements in the mode of procedure, are requested to communicate it for insertion in this Journal.

Extract from the "London Journal of Science."

The process of boring the earth for spring water, has, of late, been practiced with great success, in various parts of the kingdom. In the neighbourhood of London, many fountains of pure spring-water, have lately been obtained by these means; we may particularly name those at Tottenham, and Mitcham, both of which afford

a continuous and abundant flow of water, equal to about eight gallons per minute.

The boring is effected by means of an auger, similar to the instrument employed in boring for Coal. After boring to a depth of about sixteen feet, a cast iron tube of about that length, with an orifice of about four and a half inches, with an upper flange, is driven into the ground; the use of this tube is to exclude the land-springs, and assist in keeping the further progress of the borer, perpendicular.

Additional rods being now coupled to the auger, the boring proceeds until the spring discovers itself; which, in general, has been found at the commencement of a stratum of sand, about one hundred feet below the surface. Tin pipes of about three inches diameter, and twenty feet long, are now introduced into the bore. When the first length of pipe has been forced nearly down, another similar pipe is soldered on the top of it; the pipe is then driven further down, and a third length soldered on the top of the last, and so on, until the whole bore is encased by one continued pipe, from top to bottom; by which the earth is prevented from falling in; and the passage of the water kept perfectly clear.*

It does not appear that in any one instance, this operation has failed in procuring water; though by the spring flowing to the level of its source only, the water does not always rise up above the ground, and indeed, sometimes, does not reach the surface; but, under these circumstances, by sinking a well a short distance, the water will flow plentifully. According to the altitude of the head, or source of the spring, will be its force in rising. If the bore be made in a valley, and the source of the spring should be in the interior of a neighbouring hill, the stream would flow through the meandering fissures of the earth, and rise to its level, wherever a vent is given; and, under these circumstances, would flow above the surface of the outlet, by a pressure equal to the weight of a column of water, between its level and the altitude of its source. If the source be upon the same level with the outlet, (whatever their distance apart,) the water will flow to the surface only, without running over. But if the source should be below the level of the outlet, then it will be necessary to sink a well down to that level, and a little lower, before a free supply of water will be furnished.

The expense of this process appears to be very trivial; the charges being four-pence (sterling) the foot, for sinking the first ten feet; eight-pence for the second ten feet; twelve-pence for the third, and so on, increasing four-pence per foot at every additional ten feet of descent; this charge being for labour, exclusive of the cost of tubes; whereas, the expense of ordinary well-sinking, amounts to about eight times that sum.

* Many of the preceding and subsequent remarks, apply to the particular situations mentioned. In boring through clay, or any tenacious soil, the cast iron tube is unnecessary; and a less orifice would suffice, than is here indicated.—Ed.

Within one week, the operation of boring for the spring at Tottenham, was begun and finished; a depth of one hundred and five feet!

Answer to the Queries, "On Artificial Fountains." *By* B. Bevan, *Esq. Civil Engineer.*

Leighton Buzzard, Sept. 13, 1823.

Dear Sir,

Observing, in your very useful Repository, No. XX. p. 140, some Queries respecting the present mode of Boring for Water,—and finding none of your Correspondents have noticed the subject in the last Number,—I take the liberty of sending a few observations, in reply to the said Queries, in case you may not be already furnished with more useful particulars.

From the manner in which the art of obtaining water has been often mentioned, it might be supposed that it might be practised with success in any situation; whereas the possibility of succeeding is confined to certain districts, and depends upon the succession of the strata, and the elevation of the surface; requiring an impervious stratum of moderate thickness, resting upon an open stratum charged with water from a source of greater elevation than the surface of the spot to be bored.

If the sub-stratum is altogether porous, and open to the passage of water, it will be in vain to look for a supply above the natural outlet of the springs in the vicinity: and if the relative height of the situation, where water is required, to the outcrop of the underlying porous stratum, should not be favourable, it will also be in vain to bore: but should the surface of the district be low, and have a substratum of clay or marl to a moderate depth, an aperture made through the clay to the confined water below, will allow it to rise to the surface, and in some instances to rise many feet above the surface, up pipes properly fixed for that purpose.

At Cambridge, where this practice is very common, the substratum, after passing through the alluvial gravel and soil, is the chalk marl, or, what is commonly in that place called *gault*, and is about from 120 to 130 feet in thickness, resting upon a stratum of sand saturated with water, the outcrop of which is at a considerable distance, and much above the level of Cambridge: any opening therefore through this marl, or gault, will allow the confined water to rise; but, if no further precaution was used, it would reach the surface indeed, but, upon coming to the alluvial gravel, would be diffused in that reservoir of water constituting the more superficial springs, which are often, without any good reason, called land-springs:—therefore, to secure a supply at the surface, it is *essential* to cut off all communication with these higher springs; and this is usually done by inserting an iron pipe several feet into the water-tight stratum, and puddling or ramming strong clay round the

lower part, and continuing the pipe, by additions, as may be required, until it reaches the intended place of delivery. The hole is then bored through the clay with an auger of about four inches in diameter; and when cleared of the mud and softened clay, produced by the operation of boring; a tin tube, as large as the hole will admit, is passed from the top to the bottom, to keep open the aperture first made; and afterwards the fountain-head is fixed upon the iron pipe.

The boring-rods are generally about one inch square, of bar-iron, screwed together in lengths of 6 to 12 feet. Sets of joints may be obtained at any general iron-factory, and welded to bars of any length. The cost of rods and joints, ready for use, will be about *5s.* per yard; and the total expense of the operation, including the use of all the implements, and iron and tin pipes, to holes of 130 feet deep, is about *25l.*

It occasionally happens, that thin beds of rock are found, in boring, too hard for the auger: these are cut through by a piece substituted for the auger, in the shape of a chisel; worked continually round, in a stamping motion, until the rock is perforated: this tedious process sometimes requires two or three days to pass a rock of eight or nine inches in thickness.

The quantity of water produced at one of these apertures lately made at Cambridge, is regularly 12 gallons per minute; and at another finished this week, full 11 gallons per minute.

I am, Dear Sir, your obedient servant,

B. BEVAN.

[*Gill's Technical Repository.*

An account of the Overflowing Well, in the Garden of the Horticultural Society, at Chiswick. By JOSEPH SABINE, Esq. *Secretary to the Society.*

TURNHAM GREEN, Nov. 27, 1823.

In consequence of the success which had attended the operations of several persons in the vicinity of Chiswick, in boring for water it was determined, by the Council of the Horticultural Society, that an attempt to procure an overflowing-well should be made in the Society's Garden, for the purpose of obtaining a supply of water for various purposes; but, more particularly, to form an ornamental canal in the *Arboretum*, for the growth of hardy aquatic plants.

After the necessary inquiries had been made, it was determined that Mr. John Worsencroft, a person who had previously succeeded in making an overflowing-well for Messrs. Bird of Hammersmith, should be employed to execute the experiment. He commenced his operations upon the first of September last; and, after boring for five weeks without material interruption, tapped the spring on the 18th of October, and finally completed his task on

the following day. The depth from which the water first rose was 317 feet; and the whole depth of the well, when completed, was 329 feet; the additional 12 feet of boring having been made in order to gain a perfect opening into the bed of the spring, which flowed, when first tapped, less copiously than after the final depth was obtained. The chalk, from which the water immediately comes, is soft; but the bottom of the well is in hard chalk. The water in all the neighbouring wells appears to have been obtained at about the same depth; and the strata, through which the perforations were made, are nearly similar to those met with in the present instance.

The tackle, and the instruments used, were very simple. A scaffolding was raised, 20 feet above the proposed orifice of the well; on which a platform was fixed, to support a windlass, by which the rods used in boring were lowered into, and raised from the well. These rods were of tough iron, about an inch and a half square, and ten feet long; the ends of each screwing on to, or unscrewing from, the top of the next, as they were lowered into, or raised from, the hole. The instruments—fixed, as occasion required, to the lowest extremity of the series of rods, when in action—were augers of various dimensions, for boring; steel-chisels, for punching; and a hollow iron cylinder (called a shell,) fitted with a valve at its lower end, for bringing up soft mud. The rods, when an auger was attached to them, were turned round by means of moveable arms or dogs, which were made to lay hold of the part of the uppermost rod, at the top of the hole: the auger, being thus forced through the stratum of clay or sand, was drawn up, as soon as its cavity was filled with the substance it had loosened. The chisels were employed for punching through stones, hard chalk, or other hard substances: the rods, when these were attached, were moved by means of a powerful beam, acting as a lever, and worked by four men.

The water is discharged, at the surface of the ground, after the rate of six gallons per minute; and is capable of being carried 20 feet above the ground-level; and even then supplies a copious stream. The well is lined, for the first 186 feet, with cast-iron pipes, with a three-inch bore, jointed, by means of wrought-iron collars, which are riveted into the pipes: the succeeding 77 feet 6 inches are lined with copper-pipes of $2\frac{1}{2}$ inches bore, soldered into a single length, and resting in the chalk, through which the remainder of the hole is bored, and in which no pipes were used. The whole series of pipes was introduced at once; the hole having been prepared for them as soon as it was ascertained that the augers had reached the chalk stratum The land-springs in the gravel, above the blue clay, were kept out, in the first instance, by extra iron-pipes. The spring, which was found in the sand, below the blue clay, and above the chalk, rose to within a few feet of the surface, but did not overflow. The whole of the water of this spring is, however, excluded from the well, by the pipes with which it is lined.

The cost of the well, including that of the pipes, boring, and

every other expense whatever, did not exceed £130; and the manner in which it was executed was in every respect satisfactory. Indeed, it is impossible to speak too highly of the care, attention, and dexterity of Mr. Worsencroft, and the workmen whom he employed.

The various strata bored through were as follow:

Feet.	
19	Gravel.
162	Blue clay.
30	Coloured clay; varying from brick-red, mixed with blue and yellow, to many shades of dull purple.
22	Clay, with nearly a uniform colour of yellow ochre, occasionally mixed irregularly with gray. This was more sandy than the previous stratum. Among this, water rose in some quantity.
28.6	Soft soil, apparently composed of clay and sand. It varied very much in colour; being sometimes bright green, otherwise yellow intermixed with green, or sometimes beautifully veined with dark red and yellow.
67.6	Chalk, among which many flints were scattered. Of these, one was one foot in thickness; and so unusually hard, as to occupy the workmen three days in punching, before they could force a way through it.

The water was found, as before mentioned, at the depth of 317 feet, in a bed of soft chalk, mixed with small flints: the hole was bored 12 feet among the water; so that the total depth of the well is 329 feet; and it is supposed by the workmen, that the last piece of chalk that was brought up, sticking to their punch, was from the upper surface of a new layer of chalk, in which there is no water.

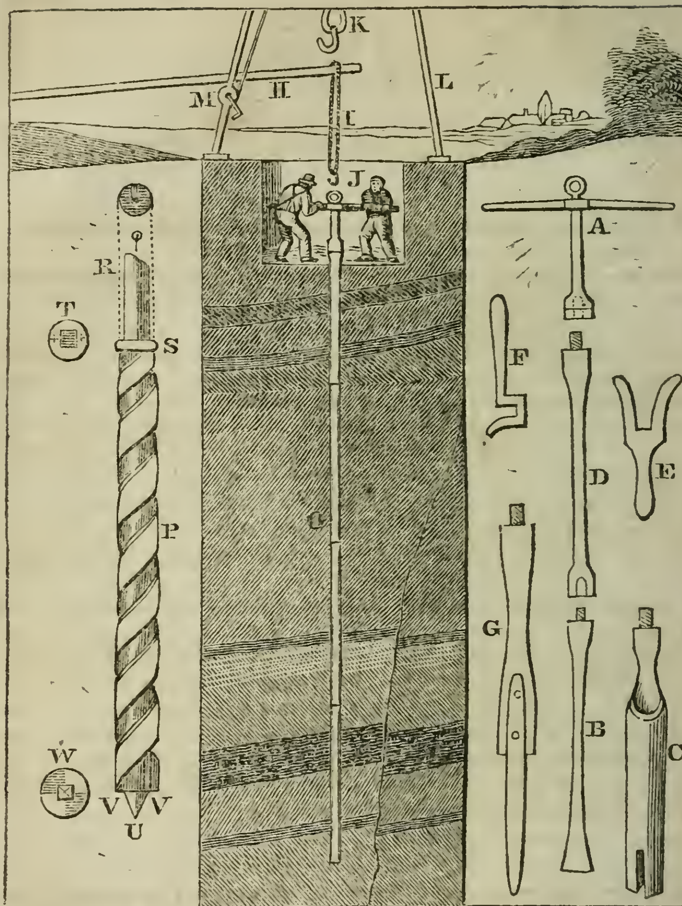
The principal impurity discovered in this water, by the action of re-agents, is common salt, of which it contains about four grains and a half in the pint. When evaporated to dryness, the residue contains a sufficient quantity of carbonate of soda, to render it very manifestly alkaline: this is also the case with the waters of the other deep wells in and about London.—[*Quarterly* (*London*) *Journal of Science, Literature, and the Arts.*

ON BORING THE EARTH, FOR WATER OR MINERALS.

To the Editor of the Register of the Arts and Sciences.

"SIR—Observing, in a late Number of the Register, some enquiry relative to the manner of boring the earth for water, I take leave to present to you such particulars of the process as I have been able to collect, accompanied with some rough drawings of the implements and the manner of using them. I should not have hazarded the probable rejection of my communication, if any talent had been requisite to describe an operation necessarily so very simple, and, if I had not, in my own opinion, made some improvements therein, which appear to be calculated to save much time and labour. I will, however, first attempt to give an account of the ordinary method, as practised in various parts of the country.

"The implements made use of, are extremely simple, and will, I trust, be understood by reference to the annexed drawings.



A is the cross-handle of the borer, for two men to work.

B the chisel borer, which is made to screw into A.

C the auger, which also screws into A.

D a lengthening rod, screws also into A at one end, and at the other end it has a hollow screw, into which is either fitted the chisel or auger—or another piece of rod; a great number of these lengths of rod are kept generally in readiness, which are screwed one into the other, so as to proceed to the depth of several hundred feet.

E a forked iron, used to lay across the hole to support the rods at the joints, whilst the pieces are being screwed and unscrewed.

F a spanner, used to screw on and unscrew the various tools and lengths of rod.

G a clearing chisel, with a probe or piercer attached to guide it.

H the spring-bar, used to produce a vibrating, up and down motion, to the chisel, when used to peck away hard or rocky ground.

I iron chain, to connect the cross-handle of the tools to the spring-bar.

J two men at work, boring with the chisel.

K the lower pulley of a pair of blocks, suspended to compasses above.

L the compasses.

M winch or crane, to work the blocks, when great weights are to be raised.

O three lengths of rods and the chisel in the act of boring—perforation about 42 feet.

P spiral worm, or auger.

Q square Iron bar passing through the square tube of the spiral worm.

R chains to draw up the spiral worm along the bar.

S top plate of spiral worm, to which the chains are affixed.

T upper view of plate, showing the square hole, through which the bar passes.

U angular point of square bar.

V V cutting auger edges.

W underside view of the bottom cutting parts of the spiral auger.

"As a preparatory measure, a large circular hole is *usually* dug to the depth of seven or eight feet, at the bottom of which a floor is formed by means of some planks for the men to work, and pace round upon, whilst using the implements.* If the earth is very soft, the only tool requisite is the auger C, of three to four inches diameter, which is screwed into the cross-handle A, and the perforation is easily effected by the mere turning of it round, by two men, as shown in the drawing. When the auger has penetrated to nearly the depth of the tube, it is withdrawn, and cleared of its contents: it is then let down again, and the perforation continued to the whole length of the instrument. To proceed to a greater depth, the lengthening rods, before described, are put into requisition. The auger is detached from the handle by unscrewing it, a piece of rod D is screwed in its place, and the auger screwed on to the rod. With the instrument thus lengthened seven or eight feet, the boring is renewed by means of the auger, as long as the earth is found to be sufficiently soft and yielding. Whenever it proves otherwise, or hard and rocky, the auger is detached from the rod, and the chisel B, which is from three to four inches in diameter at its edges, is screwed on, in its place. If the ground is not *very* hard, the boring may be continued with the chisel, by the workmen pressing upon it as they turn it round; but when the

* Instead of this, sometimes a stage is erected from ten to fourteen feet above the ground, where the men turn the boring implements, assisted by a man or two underneath it.

earth is too hard to be operated upon by the chisel in this way, recourse is had to *pecking*, which is done by lifting up the implement and striking it against the opposing substance till it is chipped away, or reduced to powder, to a certain depth. The rod and chisel are then again drawn up, and the auger substituted for the chisel, for the purpose of extracting the pulverised stony matter contained in the hole. The chisel and the auger are thus employed alternately, where the ground is hard and stony, the one for chipping away or pulverising, and the other for clearing out.

"As the perforation deepens, the process of pecking becómes very laborious, recourse is therefore had to a very simple contrivance, called the spring-bar (see H,) which affords the most effectual aid. This is a strong pole, placed horizontally over the well, at the height of three or four feet from the ground, with one end inserted into a post or other strong hold. The chain I is attached to this bar, and the handle of the borer is suspended to the hook of the chain, which supports its weight; a slight vibrating motion is then given to the bar by the workmen, which causes the chisel to peck away with great rapidity.

"As the weight of the implements becomes too great to be drawn up by hand, when the boring has proceeded to a great depth, the mechanical aid of a pair of pulley blocks (K) is used for the purpose, which are usually suspended to a tripedal standard (or triangle as it is called,) fixed over the hole. In withdrawing the rods for the purpose of bringing up the materials bored through, or for changing the tools, every piece is successively unscrewed, and upon re-introducing it into the hole, every piece is necessarily screwed on again—which renders the operation exceedingly tedious. This inconvenience, it appears to me, might be greatly lessened, by erecting a more lofty standard, such as is used in shifting the masts of ships, called *compasses;* which are formed of two long mast-spars, connected together at top, with ropes passing from the summit in a cross direction to the ground (so as to form a quadrangular figure at the base,) to secure the compasses in their position. A crane, or simple winch and ratchet wheel, might then be fixed to one of the legs of the compasses at M, which should work tackle blocks, or a single wheel and axle suspended to the upper part of it: which would enable the workmen to raise a great length of rod safely, without the necessity of the almost incessant screwing and unscrewing, which occupies full three-fourths of the time and labour. Considering the compasses as preferable to the tripedal standard, I have introduced them in lieu of it, into my drawing, (see L.)

"In the manner described, the boring proceeds; changing the tools to such as may be best suited to cut through the various strata, whether of a soft, indurated, or stony texture, until the main spring is arrived at, when the water flows up the newly formed tube, to the height of the distant spring from which it is derived. If that be at a greater altitude than the surface of the earth bored, the water rises above the ground, producing a perpetual fountain: on

the contrary, if it be below the surface, a well must be sunk of some capacity, down lower than the level of the adjacent spring, into which the water will flow, and form a reservoir, to be drawn up by means of a pump.

"The earth is sometimes bored by the before-mentioned simple instruments, to the depth of two, three, or four, hundred feet—either for the purpose of obtaining water, or to ascertain the presence of minerals. To carry on the operation at these immense depths, it is of course necessary to employ a greater power than that of the two men in the drawing; but any degree of force may evidently be obtained by lengthening the cross-bar or levers, and working them above ground, as a capstan on board a ship;—or a horse may be employed to turn the boring shaft, the same as in a mill. These contrivances, however, are only my own suggestions, and must be obvious to every body.

"When the hole is bored, a pipe of cast iron, or other metal, is forced down it, to prevent its being filled up again by the falling in of the surrounding earth, and likewise to keep out the impure land springs, which might taint the water.

"Reflecting upon the excessive labour and tediousness of the ordinary method of boring the earth, I was led to consider of some means by which the operation might be carried forward at great depths, and the earth be extracted without the necessity of withdrawing the rod, and thus save full nine-tenths of the time and labour, which are occupied in the almost perpetual screwing and unscrewing of the various pieces composing its length, every time it is let down or drawn up. The method, by which I propose to effect this desirable object is extremely simple, and I will endeavour to describe it.

"An auger is to be made with a spiral-worm, winding round a cylinder, which is to form its centre.* The cylindrical part is not to be solid, but perforated throughout its whole length with a square hole of two inches or more diameter, for the purpose of receiving within it an iron bar of the same figure and admeasurement. The bar will thus serve the double purpose of a spindle or shaft to work the auger, and cause it to bore; and as a slide, upon which it may be drawn up with facility, from very great depths, to the surface in a few seconds of time, its contents be discharged, and let down again as quickly; to proceed in the perforation of a fresh portion of earth.

"It is perhaps worthy of notice, that an auger with a spiral-worm is, independently of the other circumstances mentioned, much better adapted to boring the earth, than the common auger. First, because it requires less power to force the earth up the inclined plane of the spiral-auger, than perpendicularly up the common auger; consequently, the latter by the application of an equal force cuts its way more slowly. Secondly, because

* This figure may, perhaps, be better understood, by comparing it to a circular staircase, which is wound round and supported by a pillar in its centre.

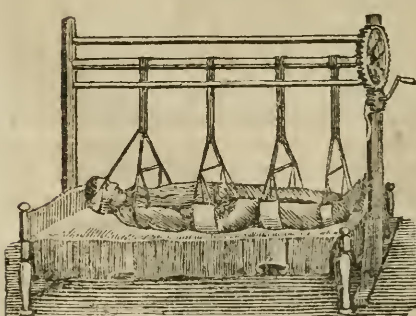
the weight of the earthy contents in the spiral-auger, lying supported on its inclined plane, adds force to the cutting, while in the common auger the perpendicular column of earth in its centre has a bearing against the edge of it, prejudicial to the cutting.

"That a part of the contents of the spiral-auger may not fall out, when being drawn up, the worm or thread is not to be left open, but to have a perpendicular border, raised upwards, at right angles with the plane of the thread, as shown in the drawing; the aperture between the upper edge of this border, and the next thread, is left open for clearing out the auger with facility; see P. The square bar, or spindle of the auger, is shown at Q; R are the chains attached to the top plate, S, of the auger, and passing over a pulley wheel, are drawn up by a rope attached to the pulley. T shows an upper view of the plate of the auger, with the square hole through it. U is the angular point of the bar, which may be formed as a chisel or any other figure. V V are the side cutting edges of the auger. W is an underside view of the auger, showing also the two under edges, which are connected with those at V V, and form right angles with them. It is evident that various kinds of tools may be fixed at the bottom of this auger so as to peck, &c.; but to go into particulars on these minor points will, perhaps, be tedious, and extend my letter, already, I fear, too lengthy for publication. I must not, however, close it without remarking, that the auger may be easily latched or bolted in its situation, should it be considered requisite, and unfastened on pulling the chains tight;—but I am of opinion, that the weight of the instrument would render the fastening of it down unnecessary; as any required force might be given by loading the upper part.

"Your constant Reader, "L. H."

FROM THE NORTH AMERICAN MEDICAL AND SURGICAL JOURNAL.

JENCKES'S ALLEVIATOR.



This machine was invented by Mr. JOHN C. JENCKES, "an ingenious and respectable mechanic," of Providence, Rhode Island, in the summer of the year 1822, whilst confined to his bed, with a fractured leg. It has since been used in different parts of our country, in hospitals, and in private families, and the inventor has obtained the certificate of some of the most distinguished surgeons, as to its great utility in all cases where individuals are long confined to bed, whether from accidents or disease. Among these names

we notice those of Drs. Warren, Ingalls, Hosack, Post, Mott, Stevens, &c. &c. In this city it has also been advantageously used. Professor Gibson recommends it as the most simple and efficacious method yet devised for the alleviation of the helpless. Mr. J. has obtained a patent for the machine.

Remarks by the Editor.—The operation of the Alleviator is sufficiently obvious, from inspecting the cut: there are, however, many situations, in the country, where it would be difficult to obtain the wheels; and a more simple mode of producing the same effect, would therefore be acceptable.

The shaft to which the straps are attached, may be made about two inches and a half in diameter; it may pass through two upright pieces, fastened to the bedstead, as above represented; or it may rest on the doublings of two ropes, suspended from the ceiling, or from the upper frame of the bedstead; the lateral motion of these ropes may be prevented by strings leading to the posts; this shaft will be easily turned by means of a cross at one end, the arms of which need not exceed 15 or 16 inches in length, from the centre of the shaft.

The Editor has not seen the specification of Mr. Jenckes's Patent, it is probable that the plan here proposed may be mentioned in it, as the principle is the same in both.

FROM THE GLASGOW MECHANICS' MAGAZINE.

An account of the Glasgow Gas-workmen's Institution. By D. Bannatyne, Esq.

It is with the greatest pleasure we insert the following interesting account of the Gas-workmen's Institution; and we earnestly hope that the publicity thus given to it, will incite the proprietors of other large works to encourage similar plans of mutual instruction among their workmen. We have never seen, nor heard of, any plan more likely to improve the moral habits of the working classes, while it improves their mental capacity, than the plans here developed; and we, therefore, earnestly entreat the attention of our readers to Mr. Bannatyne's letter.

To the Proprietors of large Manufactories.

Gentlemen,—I take this mode of addressing you on a subject in which you are deeply interested, conceiving it to be the most likely channel through which the communication I have to make, may reach you generally.

I believe there is no difference of opinion now, upon the question of giving education to the lower orders, or on the advantage of intellectual improvement, to persons in the humblest condition of life. There has, in consequence, been, for some time, a general desire to afford to the people the means of instruction; and schools for teaching reading and writing, have been multiplied in every part of the country.

But, in merely teaching the people to read, we only open to them the door to knowledge; and, unless we can induce them to pass the portal, the stores which lie within will remain useless to them. The people of the different Asiatic nations have, for an unknown period of time, had the advantage of being taught to read; but their languages supplying no practically useful works, to which they could have access, no benefit has followed the attainment; and they have not advanced their own condition beyond what it appears to have been two thousand years ago, and have not been able to furnish one solitary contribution to those means which minister to human happiness and enjoyment.

The necessity, therefore, of doing something more than simply teaching the people to read, has not latterly escaped observation. Libraries, supported by subscriptions and donations, from the higher orders, have been formed in different places for the use of Mechanics and Artizans; and establishments for teaching them the branches of science, connected with their respective employments, upon the plan of the lectures given to Mechanics in the Andersonian Institution here, have been made in Edinburgh and London, and in several of our large manufacturing towns. All this is in excellent spirit, and calculated to do much good. But to make these measures effectually and permanently useful, I am satisfied, from the observations which I have had an opportunity of making, that these establishments, after they are once set a-going, ought to be supported and conducted, in a great measure, by the people themselves, in place of being managed, as is the case at present, by their superiors.

We have had sufficient experience of the progressive relaxation which takes place in the management of public institutions, by gratuitous Directors, from the higher classes, after the fervour which had set the machine in motion, has begun to subside; and the apathy with which the working people soon come to receive every thing that is done by others for their benefit, is matter of daily complaint. But, on the other hand, wherever these same individuals can be led to consider the undertaking in which they are engaged as their own, its success never ceases to be an object of interest to them. The importance, too, which attaches to the management of such a trust, gives rise to honest feelings of self-respect, which, besides a value of perhaps still greater consideration, have their weight in keeping up the interest I have now mentioned.

These consequences which we see taking place in the opposite systems of management I have noticed, flow alike from principles inherent in our nature, and serve to indicate to us, that the more closely we can frame our measures for the people, in correspondence with their natural feelings, the more permanently successful they are likely to be.

I have considered it right to preface the communication I have to make to you, gentlemen, with these few general observations. I will now proceed to give you an account of a little institution,

formed here, for the improvement of a single body of workmen; the history of which will show what is possible to be accomplished by each of you, in the business of education, independent of what may be effected by the greater general establishments which I have taken the liberty of adverting to. If I am not mistaken, it will suggest plans for the instruction of the people, more efficacious, more easily executed, and more practically applicable to the end, than any we are yet acquainted with.

The Gas Light Chartered Company of this city, in which I hold a considerable interest, and of whose Committee of Direction I have for some years been a member, employs constantly between sixty and seventy men in the works. Twelve of these are mechanics, and the others furnace men and common labourers of different descriptions; forming, altogether, a community, not very promising as a body to be incited to adopt measures for their own intellectual improvement.

A little more than three years ago, our Manager at the works, Mr. James B. Nelson, proposed to these men to contribute each a small sum monthly, to be laid out in books, to form a library for their common use. He informed them, that if they agreed to this, the Company would give them a room to keep the books in; which should be heated and lighted for them in winter; that in this room they might meet every evening, throughout the whole year, to read and converse, in place of going to the ale-house, as many of them had been in the practice of doing. That the Company would farther give them a present of five guineas to expend on books, and that the management of the funds, library, and every thing connected with the measure, should be entrusted to a Committee of themselves, to be named, and renewed by them at fixed periods.

With a good deal of persuasion, Mr. Nelson got 14 of the workmen to agree to the plan. A commencement was thus made. For the first two years, until it could be ascertained that the members would have a proper care of the books, it was agreed that they should not take them out of the reading-room, but that they should meet there every evening to peruse them. After this period, however, the members were allowed to take the books home; and last year they met only twice a-week at the reading-room to change them, and converse upon what they had been reading. The increase of the number of subscribers to the library was at first very slow; and at the end of the second year the whole did not amount to thirty. But from conversing with one another twice a week at the library, upon the acquisitions they had been making, a taste for science, and a desire for information, began to spread among them.

They had a little before this time got an Atlas, which, they say, led them to think of purchasing a pair of Globes. And one from among themselves, Alexander Anderson, by trade a joiner, who had had the advantage of attending two courses of the lectures in the Andersonian Institution, volunteered, about the beginning of last winter, to explain to them, on the Monday evenings, the use

of the Globes. Finding himself succeed in doing this, he offered to give them, on the Thursday evenings, an account of some of the principles and processes in Mechanics and Chymistry, accompanied with a few experiments. This he effected with a simplicity of illustration and usefulness of purpose, that was delightful. He next, and while he was still going on with his lectures, undertook, along with another of the workmen, to attend in the reading-room, during the other evenings of the week, and teach such of the Members as chose it, Arithmetic.

For the business of this season, the Members of the Society, who conduct every thing themselves, have made a new arrangement.

The individuals of the Committee have come under an agreement, to give, in rotation, a lecture, either in Chymistry or Mechanics, every Thursday evening; taking Murray for their text book in the one, and Fergusson in the other. They intimate, a fortnight before, to the person whose turn it is, that he is to lecture from such a page to such a page of one of these authors. He has, in consequence, these fourteen days to make himself acquainted with his subject; and he is authorized to claim, during that period, the assistance of every Member of the Society, in preparing the chymical experiments, or making the little models of machines for illustrating his discourse.

It is a remarkable circumstance in this unique process of instruction, that there has been no backwardness found on the part of any of the individuals to undertake to lecture in his turn, nor the slightest diffidence exhibited in the execution. This I can attribute only to its being set about without pretension or affectation of knowledge, and merely as a means of mutual improvement. And nothing, I conceive, could have been better devised for accomplishing this end. Indeed, I might with confidence say, that under this simple system of mutual instruction, which has grown out of the train of circumstances above mentioned, these persons, many of whom, when they joined the Society, were in a state of complete ignorance, have acquired a clearer idea and more perfect knowledge of the subjects which have been brought under their consideration, than would be found to have been attained by any similar number of students, who had been attending the courses of lectures given in the usual way by the most approved lecturers.

On the Monday evenings the Society has a voluntary lecture from any of their number, who chooses to give notice of his intention, on either of the branches of science already mentioned, or upon any other useful subject he may propose. And there is, with the general body, the same simple, unhesitating frankness, and disposition to come forward in their turn, that exists among the Members of the Committee, with regard to the lectures prescribed to them.

I think it will be interesting, and may not be without use, to mention particularly the subjects of the different lectures that have been given since this plan was adopted. They commenced in the month of September, and are as follows:

1st, Upon solidity, inactivity, mobility, divisibility.
2nd, Attraction, cohesion, and repulsion.
3d, Attraction of gravitation.
4th, Centre of gravity, expansion of metals.
5th, Magnetism and electricity.
6th, Central forces. All motion naturally takes a rectilineal line.
7th, Mechanical powers.
8th, The lever, wheel, and axle.
9th, The pulley.
10th, The wedge and screw.
11th, Attraction of gravitation.
12th, Wheel carriages.
13th, The primitive form of chrystals.
14th, Hydrostatics.

The voluntary lectures began at the same time, and have been as follows:

1st, Upon the air pump.
2nd, Electricity.
3d, An introduction to chymistry, principally to show chymical affinity.
4th, The properties of the atmosphere.
5th, The corn-mill.
6th, Coal mining.
7th, Practical observations on the blasting of whin rocks.
8th, Boring, sinking, and mining, and the properties of Sir Humphrey Davy's lamp.
9th, The globes.
10th, Do.
11th, Navigating a vessel from the Thames to the Orkney Isles.
12th, The nature of carbonic acid gas.
13th, A description of Captain Manby's invention for the preservation of shipwrecked seamen.

The effect of all that I have been relating, has been most beneficial to the general character and happiness of these individuals; and we may readily conceive what a valuable part of the community they are likely to become, and what the state of the whole of our manufacturing operatives would be, if the people employed in every large work were enabled to adopt similar measures. What might we not then be entitled to look for in useful inventions and discoveries, from minds awakened and invigorated, by the self-discipline which such a mode of instruction requires?

The Gas Light Company, seeing the beneficial consequences resulting from the instruction of their work-people, have fitted up for them, this winter, a more commodious room to meet in for their lectures, with a small laboratory and workshop attached to it, where they can conduct their experiments, and prepare the models to be used in the lectures. The men, last year, made for themselves an air pump, and an electrifying machine; and some of them are now

constantly engaged, during their spare hours, in the laboratory and workshop.

The whole workmen, with the exception of about fifteen, have become members of the Society, and these have been standing out upon the plea that they cannot read. They are chiefly men from the remote parts of the Highlands, or from Ireland. But the others say to them, join us, and we shall teach you to read: and I have no doubt of their persuading them to do so.

The rules of the Society, which have been framed by the Members themselves, are simple and judicious. Every person on becoming a member, pays 7*s*. 6*d*. of entry-money. This sum is taken from him by instalments, and is paid back to him again should he leave the gas work, or to his family or heirs, should he die. Besides this entrance-money, each member contributes three halfpence weekly, two-thirds of which, by a rule made this year, go to the library, and one-third to the use of the laboratory and workshop. By a rule, made at the same time, which I think a curious indication of the change of feeling produced in these men in the short period since the commencement of the Society, the members may bring to the lectures any of their sons, who are above seven, and under 21 years of age.

The library now contains above three hundred volumes. These consist of elementary works of science, and books of history, voyages, travels, some of the standard poets, a few of our best novels, and Shakspeare's Works. The selection of the books, purchased by the library funds, is, in general, creditable to the Members of the Society.

They admit no books on religion into the library. The Members say that there are among them men of a variety of persuasions, Presbyterians, Seceders, Methodists, Church of England-men, and Catholics, each of whom would be for introducing books connected with their particular opinions, and thus give occasion to endless unprofitable disputes.

I hope you will agree with me, Gentlemen, in considering that there are valuable ideas on the subject of popular education, to be gathered from the little history I have just given. It appears to me that what has been so usefully done by the people at the Glasgow Gas Work, is capable of being effected, not only by the workmen in every manufacturing establishment, but in every part of the country, where a few persons can be induced to form a Society for mutual improvement. In places where there is a school-room, the use of it might be had for one or two evenings in the week, and the books might be kept in presses so placed as not to incommode the scholars. The School-master, too, might probably make a valuable member of the Committee. When assistance was wanted to procure these accommodations, the pecuniary contributions of the more wealthy persons of the neighbourhood for this end, would be doubly repaid to them in the improved character of all around them. The course of mutual instruction to be adopted in these little societies, might be varied to suit every pursuit in life, and

each society, prosecuting inquiry in the direction of the particular occupation or business of its own members, would, while they were improving themselves, be in the most likely state to furnish valuable contributions to the stock of general knowledge.

Since writing the preceding, which was some weeks ago communicated by me in a letter to Dr. Birbeck, I have read the excellent article in the last number of the Edinburgh Review, on the scientific education of the people; and am happy to find the general views I had been led to form on this subject, from what I had had an opportunity of witnessing in the different establishments here, sanctioned and confirmed by the able and enlightened writer of this article. Indeed there is so much information collected in this article, on what has been done in different parts of the country, towards instructing the people, and so many suggestions with regard to what may yet be effected, that it is to be wished that it could be printed separately, in a cheap edition, and circulated in every quarter of the country.

DUGALD BANNATYNE.

Glasgow, 25th December, 1824.

In the same number of the "Glasgow Mechanics' Magazine," which contains the preceding article, there is the subjoined query. "If it be true, as philosophers tell us, that it is owing to the porosity of bodies, that they are transparent; how is it, that some bodies, comparatively opaque, (such as common writing paper,) become comparatively transparent, by being laid over with oil? J. B."

The magazine was forwarded to a gentleman of this city, by a very distinguished literary lady; who has, under the query, made the following request:—"Pray ask some of your men of science, to reply to this query."

To give a popular answer, to a question, involving philosophical principles, is always difficult, and frequently impossible; whenever it is attempted, we must suppose the inquirer to be acquainted with the outlines, at least, of scientific knowledge; otherwise, instead of a simple reply, we must give an elementary treatise. Perhaps the following answer may be acceptable.

Those bodies are denominated transparent, through which light passes readily: this passing of the particles of light, depends much more upon the arrangement of the particles of the body, than upon its porosity. If we pulverize a piece of transparent glass, the powder will be opaque; yet its porosity will evidently be increased. Opacity and transparency, may therefore be said to be, an accidental state of bodies, in general, and not one of their inherent properties. We are not acquainted with any substance, which is not transparent under some of its modifications: charcoal is transparent in the diamond, and the metals and earths, in their solutions in acids; as well as in other states and combinations.

Light, (assuming its materiality,) is attracted by the particles and masses of other matter; and if this attraction be equal, or nearly so, on all sides, it will pass through the body upon which it falls; and that body will be called transparent: if, on the other hand, it be attracted unequally by the particles of the body, it will obey the strongest force, and its course will be changed; and if this be frequently repeated, it will not pass through, and the body will be opaque. Through a single piece of glass, the light will therefore pass readily, it being attracted equally in all directions, the density of the mass, being equal; but if we reduce this mass to powder, although each individual particle will still be transparent, the accumulated particles will not be so; the light, in passing near their angles, will be inflected; and in striking upon their sides, will be refracted; and being thus repeatedly turned out of its course, will not pass through. If we could now find a fluid of the same density with the glass, or rather one which possessed an equal attraction for the particles of light, and were to pour this upon the powdered glass, we should fill up all the interstices, and in effect, annihilate the angles and surfaces of the particles; the light would again be equally attracted on all sides, and would pass on its course. The effect would be the same as that of pouring in melted glass; or, as remelting the particles, and reducing them again to a single mass. Paper consists of particles entangled and agglutinated together, with numerous refracting and inflecting surfaces; if between them, we can insinuate an article, equal in its refracting power to the particles of the paper, it will become transparent; if we approach it only, semi-transparency will be produced, which is all we usually attain.

FOR THE FRANKLIN JOURNAL.

ON SPECIFIC GRAVITY.—No. I.*

By Robert Hare, M. D. *Professor of Chymistry in the University of Pennsylvania.*

A clear conception of Specific Gravity, is necessary, to a comprehension of the language of the most useful sciences and arts. It may be defined, the ratio of the weight of a body, to its bulk.

On the means of ascertaining Specific Gravities.

The object of all the processes for this purpose, is, either to ascertain the weight of known bulk, or the bulk of known weight. When masses are reduced to the same bulk, it is only necessary to weigh them. When they are reduced to the same weight, it is only

* It is not proposed in the former part of this article, to offer any thing new, upon the subject of Specific Gravity; it is only given as introductory to the description and use of some instruments, which, it is believed, will be found in many instances, more convenient in their application, than any which have been hitherto employed.

necessary to measure them. If water were among a number of substances reduced to the same bulk, and weighed, and its weight assumed as a unit, the numbers found, would be the same as those now in use to express specific gravities. The gravity of water has been assumed as the standard, because this fluid may almost always be had, sufficiently pure; and it is generally easy to ascertain the weight of a quantity of it, equal, in bulk, to any other body.

In order to obtain the specific gravity of a body, therefore, we have only to divide its weight, by the weight of a quantity of water equal to it in bulk.

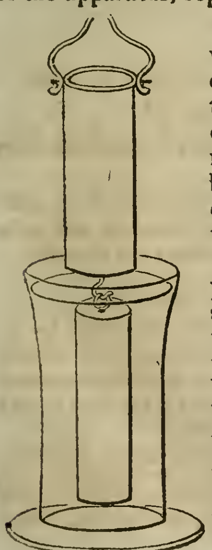
The weight of a quantity of water, equal to the body in bulk, is equal to the resistance which the body encounters in sinking in water. Hence, if we can ascertain, in weight, what is necessary to overcome the resistance which a body encounters in sinking in water, and divide, by this weight, thus ascertained, the weight of the body, we shall have its specific gravity.

In the case of a body which will sink of itself, the resistance to its sinking, is what it loses of its weight, when weighed in water.

In the case of a body which will not sink of itself, the resistance to its sinking, is its weight added to the weight which must be used to make it sink.

Experimental Demonstration, that the resistance which a body encounters, in sinking into any fluid, is just equivalent to the weight of a portion of the fluid, equalling the body in bulk.

This proposition may be experimentally demonstrated, by means of the apparatus, represented by the following figure.



V

The cylinder, represented as surrounded by the water of the vase, (V) is made to fit the cavity of the cylinder suspended over it so exactly, as that it enters the cylinder with difficulty, on account of the included air, which can only be made to pass by it slowly. It must, therefore, be evident, that the cavity of the hollow cylinder, is just equal in bulk to the solid cylinder, which so exactly fits it.

Both cylinders, (suspended as seen in the plate) being counterpoised accurately upon a scale beam; let a vessel of water be placed in the situation of the vase, in the drawing. It must be evident, that the equiponderancy must be destroyed, since the solid cylinder will be buoyed up by the water. If water be now poured into the hollow cylinder, it will be found, that, at the *same* moment *when* the cavity becomes full, the equiponderancy is restored, and the solid cylinder sunk just below the surface of the water.

It therefore appears, that the resistance which the solid cylinder encounters, in sinking in the water, is overcome by the weight of a quantity of the water equal to it in bulk. It must be evident, that the same would be true of any other body, and of any other fluid.

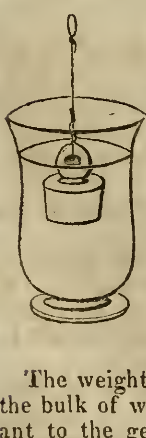
Rationale.

When a solid body is introduced into an inelastic solid, on withdrawing it, a hole is left, which remains vacant of the solid matter: but, no sooner is a body, which has been introduced into a liquid, withdrawn, than the liquid is found to fill up the space from which it has been removed.

It is evident, that the force which liquids exert, thus to re-enter any space within them, from which they are forcibly displaced, is precisely equal to the weight of a quantity of the liquid, commensurate with that space; since, when the space is re-occupied by the liquid, the equilibrium is restored. Consequently, every body, introduced into a liquid, experiences from it a resistance equal to the weight of a quantity of the liquid, commensurate with the cavity, which would be produced, supposing the liquid, frozen about the solid mass, split open so as to remove it, and the fragments put together again: and the cavity also thus created, must obviously be exactly equal to the bulk of the body. It follows, that the resistance which any body encounters in sinking, within a fluid, is equivalent to the weight of a quantity of the fluid, in bulk equal to the body.

To ascertain the Specific Gravity of a Body heavier than Water.

Let the body be the glass stopple, represented in the succeeding figure.

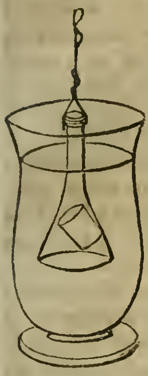


First counterpoise the stopple by means of a scale beam and weights, suspending it by a fine metallic wire. Place under the stopple, a vessel of pure water, and lower the beam, so that, if the stopple were not resisted by the water, it would be immersed in that fluid. Add just as much weight, as will counteract the resistance which the water opposes to the immersion of the stopple, and renders the beam again horizontal. Divide the weight, by which the stopple had been previously counterpoised, by the weight thus employed to sink it. The quotient will be the specific gravity.

Rationale.

The weight required to sink the stopple, is equal in weight to the bulk of water which the stopple displaces. Of course, pursuant to the general rule, it is only necessary to see how often this weight is contained in the weight of the stopple, to ascertain the specific gravity.

To ascertain the Specific Gravity of a Body lighter than water.



Let a small glass funnel be suspended from a scale beam, and counterpoised so as to be just below the surface of some water in a vase, as in this diagram.

If, while thus situated, a body lighter than water, a small cork for instance, be thrown up under the funnel, the equilibrium will be subverted. Ascertain how much weight will counteract the buoyancy of the cork, add this to its weight and divide its weight by the sum—the quotient is the answer.

Rationale.

The force with which the cork rises against the funnel, is equal to the difference between its weight and the weight of the bulk of water which it displaces. Of course, ascertaining the force with which it rises, by using just weight enough to counteract it, and adding this weight, so ascertained, to that of the cork, we have the weight of a bulk of water, equal to the bulk of the cork. By this, dividing the weight of the cork, agreeably to the general rule, the specific gravity of the cork will be found.

To ascertain the Specific Gravity of a Liquid.

Let the stopple be counterpoised, exactly as in the last experiment, only that it is unnecessary to take any account of the counterpoising weight.

Having, in like manner, ascertained how much weight will sink it in the liquid, divide this by the weight required to sink it in water, as above. The quotient will be the specific gravity sought.

Rationale.

It has been proven, that the resistance to the sinking of a body in any fluid, is precisely equal to the weight of a bulk of the fluid, equal to the bulk of the body. Ascertaining the resistance to the immersion of the same body in different fluids, is, therefore, the same as ascertaining the weights of bulks of those fluids, equal to the body, and, of course, to each other. And if one of the liquids be water, the weight of this, divided by the weight of the others, gives their specific gravities.

If the stopple be so proportioned, as to lose just one thousand grains, by immersion in water, division is unnecessary, as the weight of the liquid will be obtained in grains, which are thousandths by the premises. A metallic mass, of the same weight as the stopple exactly, may be employed as its counterpoise.

In these experiments, the liquid should be as near 60° of Fahrenheit's Thermometer as possible.

On the application of the sliding rod measurement, in Hydrometry.

There is, in my opinion, no mode of measuring fluids, heretofore contrived, so accurate and convenient, as that which I have employed in my Eudiometers. I allude to the contrivance of a rod,

or piston, sliding through a collar of leathers into a tube, and expelling from it any contained fluid, in quantities measured by degrees marked upon the rod; and perused, with additional accuracy, by means of a vernier.

One of the most advantageous applications of the mechanism alluded to, is, in ascertaining specific gravities, in the case either of liquids or solids. To assay liquids which are not corrosive, I have employed two instruments like that represented in the following figure, severally graduated to 100 degrees, and furnished with a vernier, by which those degrees may be divided into tenths, and each scale made equivalent to 1000 parts.

In order to avoid circumlocution, I shall, to the instrument here represented, give the name of *Chyometer;* from the Greek, *chuo*, to pour, and *meter*, measure.

Supposing two such instruments to be filled, to the extent of the graduation, one with pure water, the other with any spirituous liquid, lighter than water, whose gravity is to be found; let 1000 parts of the liquid be excluded into one scale of a beam, and then exclude into the other scale as much water as will balance it. Inspecting the graduation of the Chyometer, from which the water has been expelled, the numbers observed, will be the answer sought. For, supposing 1000 measures of alcohol were placed in one scale, if 800 measures of water counterbalance it, the alcohol must be to the water, in weight, as 800 to 1000; which is all that is requisite to be known: since it is self-evident, that when any two masses are made equal in weight, their gravities must be inversely as their bulks.

To ascertain the specific gravity of a solid, by the Chyometer.

For this purpose, the body, whose gravity is in question, should be suspended in the usual way, beneath one of the scales of a balance, and its weight, in parts of water, at 60° F. ascertained, by measuring from the Chyometer, into the opposite scale, as many parts as will balance the body. Being thus equipoised, and a vessel of pure water, at the same temperature as that introduced by

the Chyometer, duly placed under it; the number of parts of water, competent exactly to cause it to be merged in this fluid, will be the weight of a quantity of water, equivalent in bulk to the body. Of course, dividing, by the number thus observed, the weight of the body, in parts of water as previously found, the quotient will be the specific gravity sought.

This process ought to be easily understood, since it differs from the usual process only, in using measures of water, instead of the brass weights, ordinarily employed.

The Chyometer enables us to make new weights, out of water, for each process.

To ascertain the specific gravity of a corrosive fluid, by the Chyometer.

The process, described in the preceding page, is only applicable, where the fluid is not of a nature to act upon the sliding rod. By employing a body—a glass bulb for instance—appended from a balance, as in the usual process, we may use water, measured by the Chyometer, in lieu of weights.

First, having counterbalanced the body exactly, ascertain how many parts of water will cause it to sink in water; next, how many parts will cause it to sink in the liquid, whose gravity is to be ascertained. The number last found, being divided by the first, the quotient is the specific gravity sought.

Supposing that the graduation be made to correspond with the size of the bulb, so that 1000 parts of pure water will just sink the bulb in another portion of the same fluid; the process for any other liquid, will be, simply to ascertain how many parts of water will sink the globe in it. The number observed, will be the specific gravity; so that recourse to water, or to calculation, would be unnecessary.

The rationale of this last mentioned process, is given, in the case of ascertaining the gravity of liquids, by the glass stopple, weighing 1000 grains.—(See page 45.)

[TO BE CONTINUED.]

IRON AND STEEL.

The Technical Repository contains a series of valuable papers, written by the Editor of that Journal, on the subject of iron and steel. These it is intended to republish, with such remarks and observations, as may be deemed useful to the operative mechanic. All the arts of civilized life depend, immediately, or remotely, upon the use of iron; and numerous have been the improvements made within a very few years, particularly in England, in the casting, and in the conversion of cast, into malleable iron, and of the latter, into steel; as also in improving their qualities, in a degree which, a few years since, would have been thought impracticable.

Who would have believed, that nails might be made of cast iron, and softened so that they would clinch, like wrought iron?—that horse-shoes, would be cast, and that when worn out, from the remnants would be made excellent razors? Yet all this, and much more has been accomplished. The Editor is aware that, in publishing these observations, he subjects himself to the charge of "shooting with a long gun." But his information is so direct, and from authority so good, as to remove every doubt upon the subject, from his own mind; and he hopes to be enabled at an early day, to add to the annunciation of the fact, the means by which these objects are attained.

Many of the facts detailed in the papers to which we have alluded, are already known to a number of our practical mechanics, some of whom are undoubtedly acquainted with other facts of equal, or greater value. Originality is not so much our object, as the diffusion of that knowledge among the great body of workmen, which is now confined to a comparatively small number; those who can aid us in this work, will not only oblige us, but confer a benefit on the public, by making known, through the medium of our pages, the result of their experience.

On Iron and Steel, by Thomas Gill.—No. I.

In this article, the Editor gives to the Public the successful results of many years' experience of his late Father, himself, and others.

The directions given, will be found to differ very considerably indeed, from the methods in common use: but nothing short of the great pains taken in first ascertaining the good qualities of the materials employed, and secondly in bestowing the most accurate and minute attention to follow the directions given, can insure the excellence of the articles manufactured therefrom;—such, for instance, as smooth files, which have now been in constant use for upwards of half a century, and are esteemed invaluable by their possessors;—hand-saws, which retained their original excellence of temper, until, by constant wear and sharpening, they became turning-saws, and finally key-hole saws; and sword-blades, which were capable of cutting gun-barrels asunder, and could afterwards be wrapped around other gun-barrels without breaking; and, possessing, in short, in perfection, the very opposite qualities of both hardness and toughness! These, and many other articles equally excellent, are well known, by many, to have been manufactured by the Editor's late father. And when it is understood that the Editor has availed himself of the knowledge he inherited from his father, to engraft thereon the additional improvements, which his extensive acquaintance, amongst the first practical men in this metropolis, has enabled him to acquire, he trusts that the Public will consider him duly qualified to undertake the task.

On the kinds of Iron proper for Cast Steel.

The best iron for this purpose is Swedish, of the marks (L) and PL, termed Hoop L, and PL: and the next best are marked $\substack{*\\*}$ or $\substack{\circ\\\circ}$ *i. e.* double star, or double bullet. The Swedish Government ensures the quality of the iron according to its mark: and although many other marks are imported by the merchants, and these the dearest, yet those above mentioned ought to be preferred, where cast steel of a good quality is required. The above marks are on iron made from the Dannemora or Oregrund ores, which are chiefly carbonates and oxides of iron.

On the conversion of Iron into Steel.

This is effected by inclosing it in earthen coffers, surrounded by, and covered with, charcoal, and heated in a proper furnace, (as described in the Transactions of the Manchester Society; and in Vol. I. of the Philosophical Magazine,) until, on trial, it is found to be sufficiently converted. The hardest will be found to be blistered all over its surface, whilst the milder will be smoother; and great use may be made of these indications, in selecting steel for various purposes. For cast-steel, due care should be taken that the bars are converted entirely through; as, otherwise, great difficulty will occur in fusing it, and its quality will be impaired.

On the due selection of Steel, after conversion.

Here the indications, mentioned under the last head, must be employed: for instance; for hard steel, that most covered with large blisters must be chosen; for milder steel, that which has smaller ones; and for softer and still milder steel, the smoothest must be selected, and kept apart for fusion into ingots of cast-steel, of those different qualities. And, indeed, such a selection ought to be made in choosing steel for any other purpose; as blister-steel, or for making it into shear-steel, German-steel, &c.; for that kind of steel which is fit for making razors, saw-files, and other hard implements, is by no means fit for saws, sword-blades, springs, &c.: the first-mentioned articles requiring steel of a hard quality; whilst the latter should be made of mild steel.

On fusing Steel into ingots.

The steel, after such selection, must now be broken into proper lengths, and put into large crucibles or melting-pots; and covered with a mixture of quick-lime and powdered green-glass, as a flux, and to prevent oxidation: it is then fused in a powerful wind furnace; and poured into cast-iron moulds, made in two parts, and bound together by screws, or by rings with wedges interposed, to form it into ingots, of a proper shape for making bar-steel, sheet-steel, &c.;—the sharp corners, or angles, being, however, in all cases, removed, to prevent cracks in drawing the steel into bars;

and care being taken to have them large enough for the steel to be sufficiently condensed for use, when drawn into bars, or rolled into sheets.

On working ingots of Cast-steel into bars.

The ingots should be heated only to a *worm red,* and then be subjected to the blows of a heavy forge-hammer; at first moving but slowly, until the sponginess of the ingot is overcome, and the steel acquires more cohesion; when the motion of the hammer may be increased gradually, and the bars drawn to their proper size: but, above all things, over-heating it should be carefully avoided, where the good quality of the steel is to be preserved; notwithstanding the greater length of time necessary to be employed in this operation.

On working Cast-steel.

Here the precautions, recommended under the last head, of Working Cast-steel ingots into bars, ought to be particularly attended to; for, notwithstanding what has been published by Horne, in his Essays concerning Iron and Steel, (1773,) in regard to restoring the properties of over-heated steel, it is a fact, *that there is no remedy for this evil;* and, therefore, where the good quality of the articles is a principal object, we again repeat, that the steel should be worked with the least possible heat to forge it, notwithstanding the additional labour and time requisite in that operation; and particularly for the harder kinds, where a little carelessness in this respect would cause the steel to fly to pieces under the hammer.

On proving the qualities of Cast-steel.

The bars must be carefully heated at one end, and drawn down to a proper thinness for bending, about two inches in length, half an inch in breadth, and from one-eighth to one-sixteenth of an inch in thickness: this part must be then heated to the proper degree for hardening, (of which see more hereafter) and quenched, leaving the thick part of the bar still hot; and then be blazed off to a spring temper, (which will also be hereafter described) and again quenched. They are then fit for proving; which is effected by screwing about half an inch of the small end of the hardened and tempered part, horizontally, into the chaps of a vice firmly fixed to a work-bench, and then using the bar as a lever, walking round the vice, and bending it, until it either snaps suddenly short on being but little bent,—which marks it to be *hard;* bends until it has been carried round a quarter of a circle, and then breaks quietly off,—which marks it to be of *mild* or middling quality; or until it has been carried round a full half circle, and then only tears asunder, like lead,—which proves it to be of a *soft* quality, and well adapted for springs. The bars should now be accordingly marked with chalk, or in any other more permanent manner, with either of the letters H, M, or S, in order to distinguish their qualities into *Hard, Mild,* or *Soft,* at any future period. Should the first essay not

prove satisfactory, the operation should be repeated; which the length of the part hardened and tempered will permit: for sometimes the small end may be too thin, or it may be over-heated in forging, hardening, or tempering it; which is not so likely to happen to the part adjacent to it: and when the trial has been made, the small part, so drawn out, may be broken off from the bars.

It is evident, that the same method of proving the qualities of cast-steel is applicable to all the cast-steel sold in the shops: and surely every good workman will now gladly avail himself of a certain method of assorting his steel, so as to suit the various purposes he has occasion to employ it in. And it may be observed, that every part of a bar of cast-steel will prove of the same quality as the part proved, however various the different bars themselves may be.

On hardening Cast-steel.

Great care is, indeed, necessary, in this operation: for, after all the pains taken in working the steel, the whole fruits thereof may be lost, *if it be ever so little over-heated in hardening it;* and, therefore, an essay should be made, by hardening part of the same bar, from which the articles were made: trying first, even *below* the hardening heat; and if, on quenching, it should prove soft, heating it again *a little* more; and so on, by degrees, until the proper, or lowest degree of heat is ascertained, at which it will harden;—and the same degree of heat should be carefully observed, with all the articles made from that bar. When the proper degree of heat is attained, the article may be quenched, in ordinary cases in rain water; but, if for saws, or springs, in proper hardening liquids, of which more hereafter.

To detect flaws, or cracks, in hardening.

Warm the article a little, by drawing it through the fire, and then through the coal-dust on the hearth; and immediately apply a little oil all along one side of it, with a feather: in a short time, the oil will penetrate the cracks, if any exist, and appear on the opposite side, in dark marks upon the dust.

In this way, and before much cost has been bestowed upon the articles, may such flaws be detected; which would afterwards have appeared, when the expensive operations of grinding, polishing, &c. had been performed upon them.

On rendering Gravers capable of Engraving Steel-Plates. By Mr. EDMUND TURRELL.

No. 46, *Clarendon-street, Somers-town, October* 15, 1825.

Dear Sir,

As you have already published, in your *Technical Repository*, my *menstruum for etching steel-plates,* I think it desirable that you

should likewise add thereto a method, which necessity, the mother of invention, compelled me to adopt, of improving the quality of gravers, so as to render them capable of engraving steel-plates; and which may, possibly, also be applicable to many other useful purposes, in improving the edges of cutting instruments.

My writing engraver was under the necessity of informing me, some time since, that he should be obliged to give up the task of engraving upon steel plates, owing to the impossibility of finding any gravers capable of cutting them, without the almost endless repetition of their points breaking. This put me upon the necessity of employing all those resources, which opportunity had furnished me with the means of acquiring, in improving the quality of gravers; and, luckily, I hit upon the following simple and effectual method of accomplishing my object.

I had, formerly, been much in the habit of seeing the singular manner, in which, the watch-spring makers, in Clerkenwell, treat the steel their springs are made of. They are made of steel-wire, of a proper quality, and of various diameters, according to the breadth and thickness of the springs to be made thereof, and are spread by the hammer, when cold, into the thin plates forming the springs. After being brought to a certain thinness and width, they are hardened, and then tempered, over the flame of a spirit lamp, to the spring temper, or, as it is termed, the raven's gray colour; they are then subjected to the *planishing and condensing* action of the hammer, to bring them to the proper degree of thinness and breadth to form the springs; and being then brightened, by a method which it is unnecessary to describe here, but which may, probably, furnish part of an article, I have in contemplation to supply you with, on the manufacture of these highly important articles; they are, lastly, *blued*, over the flame of a spirit lamp.

Now, previous to their being *blued*, they had, by the planishing, condensing, and polishing, apparently lost all their elasticity and hardness, and could be readily bent in any manner, and would afterwards remain so bent, as though they had never been hardened and tempered at all; and yet, upon being *blued*, they regained all that *elasticity*, for which they are so highly esteemed.

Considering the above facts, I thought that, upon *tempering a graver*, though not to the degree used by the watch-spring makers, it might, possibly, be rendered capable of being acted upon by the blows of a hammer, so as *to condense the pores of the steel, opened, as they inevitably must be, by the heat necessary in even the most careful hardening;* but still more so in the usual manner of making gravers in great numbers; and, accordingly, *I tempered a graver to the straw-colour only*, and had the satisfaction to find that, on laying the back of it upon a rounded anvil, I could, by the repetition of gentle blows, with the flat cross-pane of a small and very hard cast-steel watch-maker's hammer, succeed in *rounding* or *blunting* the *acute edge* of the belly of it considerably; thus proving that *it had undergone a great degree of condensation;* and upon again tempering it to a *straw-colour*, and grinding and whetting the edge

to its proper shape, *the graver readily cut the steel-plate*, and continued to do so, it being evidently also much *toughened* by this additional labour.

I have since repeatedly succeeded, in thus improving the quality of those Lancashire or Sheffield gravers, which are to be met with in the tool shops; and, with such gravers, my writing engraver has now much less difficulty in performing his work, on steel-plates, than before.

It must be evident to any person, who reflects on the general methods of treating steel, that *the more it is condensed by hammering*, the more will the attraction of cohesion between its particles be encreased; and, consequently, the *toughness* of the metal be also greatly promoted. To effect this desirable object, many persons hammer their steel articles, when cold, for a considerable time before heating them, to harden them by quenching in a suitable fluid; but, unfortunately, the very operation of heating them must, of necessity, in a considerable degree, destroy the good effects produced by the previous cold hammering upon them, and thereby prevent, in a great measure, the advantages contemplated. But, by adopting the method described above, and the value of which I have verified by considerable experience, advantage may be taken of every improvement that has hitherto been practised in the art of making gravers, while *additional and most valuable qualities* may be given to them, and by means extremely simple, and easily applied by every engraver to his own tools.

I am happy to add, that this method of treating or improving the quality of gravers, has also been applied, by one of our first mechanics, Mr. P. Keir, to turning tools; and which were found to stand their work much better, than when simply hardened and reduced, by tempering, in the usual manner, to a straw-colour.

Should these observations be deemed worthy of a place in your valuable work, I shall feel much gratified in laying before the public, through its means, the result of my experience.

I am, dear sir, yours very sincerely,

EDMUND TURRELL.

To T. Gill, Esq.

Observations by the Editor.

This process of Mr. Turrell's of *hammer-hardening* his gravers on their angular edges *cold*, valuable as it undoubtedly is, may, nevertheless, admit of improvement. *If the gravers were to be heated to the tempering degree, at the time of hammering them, the condensing effect of the hammer would be much greater;* and no possible harm could result from that degree of heat being *then* employed; a heat, indeed, to which he himself subjects them, both before and after hammering them.

Our readers will find the Editor's process for making gravers and etching needles described in Vol. VII. of this work, page 241; they were sufficiently *dense* for engraving on *copper*-plates; but for *steel-plates*, no doubt the *closing the pores of the steel, after hardening them*, in the above manner, would be an improvement.

We have described the mode of *setting steel articles straight*, which have warped by hardening, *by heating them to the tempering heat, at the time of setting them*, in our articles "*on iron and steel*," in Vol. I. page 214, to which we must refer our readers; only observing, that the steel is, *when so heated*, much more *yielding*, and susceptible of receiving the impression of the hammer, than when it is *cold*.

The Editor has suggested to Mr. Turrell the advantage of hammering his gravers at the tempering heat, and he intends to adopt that practice on the next occasion.

Mr. Jacob Perkins, on being informed, by the Editor, of Mr. Turrell's great improvement in his gravers, and of the above suggestion of hammering them while hot, immediately stated that he had recommended an edge-tool maker, in the United States, twenty years since, to *hammer harden his axes, &c. at the tempering heat, and to continue hammering them till cold;* and which practice he adopted, and made a fortune from the great estimation in which his tools were held there. What is more curious, Mr. Perkins derived the hint of hammer-hardening from the very same practice that Mr. Turrell did; namely, from that of a watch-spring maker in America. One would naturally hence suppose, that Mr. Perkins had been informed by the Editor of the source from whence Mr. Turrell derived his idea; but this was impossible, as it was mentioned to the Editor by Mr. Perkins, before he informed him of the coincidence of their ideas! We had before known of Mr. Perkins's great experience in the difficult art of treating steel, from the admirable processes employed by him in his Siderography.

In slender articles, like the graver for instance, where they may cool too soon, or before they have sustained the full action of hammering, it may be well to brighten them partially, by rubbing them with a piece of coarse grit-stone, and again to submit them to the tempering heat, and hammer them while hot; and so proceed repeatedly, until they are sufficiently condensed.

Mr. Turrell finds that, after hammering his gravers a certain time, they yield a sharp ringing sound to the blows, very different to that, which they afforded on his beginning to hammer them; and that, after perceiving that sound, he does not find that the hammer exercises any further action upon them, in condensing them; possibly, a renewal of the heat may promote their further condensation.—[*Gill's Technical Repository.*

On the French Mode of treating Scythes, by hammering them Cold.

We happened to mention *Mr. Turrell's great improvement in gravers*, to our worthy correspondent who furnished us with the notice on the French method of treating scythes, described in our third volume, page 63, viz. by placing the scythe *flatways* upon a portable anvil, fixed in the head of a stake driven into the earth, and hammering its edge dexterously all along it with gentle strokes

of a hammer, and he immediately noticed the very great analogy in the two methods, though applied in a different manner, and to very different purposes; *and Mr. Turrell's great success in the improvement of that highly important implement, the graver*, fully warrants us in the conclusion, that *the scythe must likewise be greatly improved by the condensing effect of the blows of the hammer, upon the flat sides of its edge.* Thus the one improvement throws an additional light upon the other; and we shall gladly learn the success of the application of this valuable practice of *hammer-hardening in the cold*, after the usual hardening and tempering processes, to such objects as it may, and no doubt will, now be very shortly employed upon.—[*Ib.*

On the advantages of improving the qualities of Cutting Instruments, by Burnishing, and thereby condensing their Edges. By the Editor.

The *condensing process* of *hammer-hardening* the edges of cutting instruments, such as the graver and scythe, has naturally led us to consider the action of the burnisher upon the edges of other cutting instruments in a similar light, and to infer that a great part of the benefit derived therefrom, must be owing to *its condensing effect*, as well also to its giving the edges a greater degree of smoothness, and in some cases a more favourable position for effecting the different purposes they are applied to.

The currier's shaving knife is the first instance we shall quote, where, after renewing its edge, by whetting it upon the proper whet-stone, as well as continually during its use, *the edge is always burnished.*

The next, and a familiar example, is in the *steel scraper* used by the cabinet makers, to smoothen the surface of hard wood, after the toothed plane, previous to varnishing or polishing of it. When the edge of this hardened and tempered flat piece of sheet steel becomes dull, it is renovated by placing it upright, and whetting it upon the oil-stone; it is then whetted upon each side, to remove the burs; and, lastly, *burnished upon the face of it, towards each side, so as to throw the edges outwards.* It is held in *a sloping direction* in use, exactly as a piece of broken window-glass is held, when used as a shave, for which, however, it is an admirable substitute, as it performs its work in a similar, though much more perfect manner.

The next example is furnished from the practice of a late ingenious mathematical instrument maker, Mr. R. Fidler, who was continually employed by the late Mr. W. Lowry, the celebrated engraver, when he had any instruments to be made, for his business of mechanical engraving, which required particular accuracy in their construction. He was in the habit of *finishing his turning tools for brass*, after forming them into shape, and whetting them, *by burnishing their edges from their sides towards their flat faces*, and thus giving them *a hardness and smoothness* not to be acquired in any other way; and, in fact, they *polished* the brass-work turned by them.

The last instance is borrowed from the practice of a late eminent mechanic in the country. He was employed to make some *hardened and tempered steel cutters* for an engine, and which were to be driven with great velocity by a steam-engine, at Manchester, for a cotton mill there; *to cut brass toothed wheels and pinions, they requiring to be cut, rounded-off, and polished, at once!*

After properly shaping them, (which shape, however, we shall not describe here, as it deserves to form an article of itself,) and *skive-grinding* the faces of their teeth, he finished them by *burnishing their edges forwards, from their sides to their flat faces*, and their effects *in cutting and polishing the teeth at once, were truly wonderful.*—[*Ib.*

On a Factitious Silvering or Gilding, used in India. By John Robinson, Esq. F.R.S.E.

The Mochees and Nuqquashes of India, who are the makers and painters of a variety of objects whose purposes require ability to stand the effects of the weather, use an application, in ornamenting their work, which, in appearance, nearly equals gilding, and costs little more than common paint. It appears to me that this application might be useful, in some cases, in this country; particularly in chain-bridges, and other works where iron of a smooth surface is exposed to the atmosphere. I use the freedom, therefore, of troubling you with what I recollect on the subject.

In preparing the factitious silvering or gilding in the small way, a quantity of pure tin is melted, and poured into a joint of bamboo, (perhaps a foot long, and two or three inches in diameter,) close at both ends, except the perforation at which the tin is poured in, which is instantly plugged up. The bamboo is then violently shaken, which, if well managed, soon makes the metal assume the form of a *very fine* gray powder; this being sifted, to separate any coarse particles, is mixed up in thin melted glue, and, if I recollect right, is levigated on a stone with a muller. The result is poured into dishes (commonly cocoa nut shells) to settle, and the superfluous moisture poured off.

When to be applied, it should be of the consistence of thin cream; and is laid on with a soft brush, like ordinary paint. When dry, it appears like a coat of common gray water-colour. This is gone over with an agate-burnisher, and then forms a surface of polished tin; a coating of white or coloured roghun (oil-varnish) being immediately laid over it, according as it may be intended to imitate silvering or gilding.

I have had tent-poles, travelling trunks, baskets, covered with painted leather, and other articles, in constant wear and tear for years; in which, from its cheapness, this mode of ornamenting had been very liberally applied; and have often had occasion to remark the power which it appeared to have of resisting the effects of the weather.

On a first trial, some difficulty of manipulation may be found, in bringing the tin to a sufficiently impalpable powder, and also in hitting the proper quantity of glue to be put in. If the size be too strong, the agate has no effect; and if too weak, the tin crumbles off under the burnisher. A very little practice will make the process exceedingly easy.

NOTE BY MR. GILL.—We have extracted the above article from the Edinburgh Philosophical Journal, with a view of diffusing this useful process more extensively in this country; and also to point out the application of the *granulated tin* to the silvering and gilding of leather, in place of *leaf-silver*, and then varnishing it with a white or yellow lacker.

The granulating of tin or lead is, in this country, generally performed in a wooden box, made to shut closely, and previously rubbed over on its inside with chalk, to prevent the metals from adhering to the wood; and we apprehend, that if the powdered tin be finely searced previously to mixing it with the size, there will be no occasion for the levigation mentioned by Mr. Robison.

We have repeatedly seen iron articles from India, ornamented in the above manner, such as the hilts or handles of sabres, the furniture of their sheaths, &c.; but had always supposed them to have been coated with tin, by dipping them into the fused metal, in the manner commonly practised in this country; and which, for articles small enough to be treated in this way, is a very useful process, on account of the close adhesion of the tin to the iron.

PATENTS.

Every person acquainted with general Science, and particularly with Mechanics, has had frequent occasion to notice the numerous Patents obtained, both at home and abroad, for things which are altogether worthless, or for such as have been long known, and extensively used. To copy the whole of the specifications of foreign and domestic patents, would be to establish an extensive manufactory of waste paper—a business in which the Editor is determined not to engage. Arrangements have been made for obtaining from Washington, a list of all new patents, which will be published in this Journal; as also either a complete, or selected, list of those granted in England. Specifications of such as are deemed useful, will frequently be inserted.

ENGLISH PATENTS.

To RICHARD BADNALL, *the Younger, of Leek, in the County of Stafford, Silk Manufacturer, for certain Improvements in Dying.*

The object of these improvements is to produce a colour from Prussian Blue that shall be permanent when employed in dying

silk, cotton, wool, or other articles. This dye is prepared by grinding Prussian Blue as fine as possible, and then mixing it with strong Muriatic Acid, in a glass or earthen vessel. The acid is to be poured upon the ground colour, in small quantities, and the mass well stirred up during the mixing, until the whole has become of a smooth semi-fluid consistence.

The proportionate quantity of the acid to that of the colour is not important, provided the materials be well mixed, as above described. This composition is called the "*prepared Prussian Blue,*" and may be used as soon as mixed, but is better if allowed to stand three or four days, and is not deteriorated by age.

If silk is to be dyed, it is first deprived of its gum, by the usual means, and then immersed in a cold solution of alum in water, for three or four hours; it is then to be rinsed in clear water, which renders it in a proper state for the dye vat.

The dye is produced by the Prussian Blue, above prepared, diluted with cold water to the required strength. The silk having been introduced into the vat in hanks, suspended upon rods, it is to be there constantly turned about, that the colour may become equal throughout, and remain in the dye until the proper tint is obtained; after which it is to be washed as usual in a running stream, till the water ceases to be tinged by it. The silk is then dried, either in a shady place in the open air, or in a drying room, the temperature of which does not exceed summer heat.

From the Prussian Blue, prepared as above, several variations of colour may be made, as greens and purples, by mixing the ordinary ingredients with the blue, or dipping the articles to be dyed at several times, into the different colours to produce the tint; which operation is not particularly explained, as the substance of the invention consists in "a mode of preparing Prussian Blue, so as to dye silk, cotton, or any other article, either alone or mixed and combined with other dying materials."

The second part of the invention, is the application of pressure in dying in general, "whether it be that of thick cloths, hats, woods for veneering, or any other purpose; or any other, or more delicate materials; such as linen, cotton, or silk goods, lace, &c." The materials intended to be dyed, are immersed in the dying liquor, in a suitable vessel, which is closed with a water-tight cover, leaving only a small aperture: to this aperture a hydrostatic pump is attached, or a column of water or mercury is employed, upon the principle of *Bramah's press*, until a sufficient pressure is obtained.

If the goods are put into the vat in a dry state, or rendered nearly so by wringing, the effect will be considerably improved, and the operation facilitated by this mode of pressing the dying liquor into the pores of the materials operated upon. If found necessary, mechanical means may be resorted to for agitating the goods, or wringing them while under the pressure; such mechanical contrivance, however, is not claimed, except in conjunction with the hydrostatic pressure above described.

[*London Journal of Arts and Sciences.*

Specification of the Patent granted to JOSEPH MANTON, *of Hanover-square, in the parish of Saint George, Hanover-square, in the county of Middlesex, gun-maker; for a certain improvement in Shot.* Dated March 25, 1825.

I, the said Joseph Manton, do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows: (that is to say) my said invention of a certain improvement in shot, is applicable to the lead shot, commonly used in fowling-pieces for killing game and other purposes, and consists in coating the surface of the shot with the metal called mercury, or quicksilver, whereby it is rendered white, much more convenient for use, more cleanly, and not so liable to injure the quality of the game killed by it, as when prepared in the usual manner; nor to adhere to the barrels of fowling-pieces; and I hereby claim as my invention any and every mode by which lead shot may be coated with mercury or quicksilver. As, however, it is desirable that I should afford an example of a method or methods of carrying my said invention into effect, I shall proceed to do so as follows. I take the lead shot, in preference, before it is glazed with plumbago or black lead, and put it into a vessel either of a globular or barrel shape, which can be closed, and which I prefer to be made of iron, and capable of receiving either a revolving movement on an axis, or of being agitated backwards and forwards, or in any other fit and proper manner. Into this vessel or vessels, I put about one hundred pounds weight of lead shot, and about one pound of mercury or quicksilver, and nearly fill it with water; I then briskly stir or agitate the whole together, until I find, on trial, that the whole of the mercury or quicksilver has spread and diffused itself uniformly, and coated the surface of the shot; after which I wash it well in water. I then spread the shot upon a cloth or canvass, which is stretched on a frame of wood, and rub the shot with a sponge or cloth, which will make it dry quicker. Should the shot lose its silvery colour by being kept a long time, it may be restored by again putting it into a revolving vessel, or one capable of being shaken or agitated, together with some water, and a little mercury or quicksilver, and be treated as before mentioned.

The editor of the *Repository* observes—We have seen specimens of this improved shot, and which fully appear to us to justify the encomiums passed upon it in the above specification.

[*Gill's Technical Repository.*

To MATTHEW WILKS, *of Dartford, Kent, Seed-crusher, for his Method of refining Oil produced from Seed.*

The method adopted by the patentee in purifying oil produced from linseed, or any other description of seeds, is simple, and consists in the following process.

Into two hundred and thirty-six gallons of linseed oil, or oil

procured from any other seed, six pounds of oil of vitriol is to be poured, and well mixed by beating and stirring for about three hours. Six pounds of Fuller's earth is then mixed up with fourteen pounds of hot lime, and these matters when properly incorporated together, are thrown into the vessel containing the oil and vitriol, when the whole is to be kept in complete agitation for about three hours.

The above mixture is now to be introduced into a boiler containing a quantity of water equal to that of the oil, and the whole boiled together for three hours, keeping it continually agitated during the boiling.

The fire is now to be withdrawn from the boiler, and the materials within allowed to cool, after which the water is to be drawn off, and the oil will be found clarified, which after standing for some time, will be fit for use. [*Ibid.*

On the Rectification of Spirituous Liquors without Heat. By M. E. Pajot Decharme.

Hitherto alcohol, in liquors, or spirits, could not be rectified, or raised from an inferior to a higher degree, and consequently be brought to a superior state of purity and strength, except by distillation; an operation which could only be effected by an alembic, and some heat.

The mode of rectification here treated of, can be performed in the cold, and, consequently, without the aid of an alembic, or of combustibles. The following, in general, is the method of proceeding:—

On the one part there is poured into a vessel, with a flat bottom, a given quantity of the spirits, which is desired to be rectified, whether it be small spirits (*petites eaux,*) proof spirits of Holland, or spirits of a higher degree.

On the other part, one of the most deliquescent salts is to be dried, either muriate of lime, or muriate of manganese; the first is preferable in point of economy, and the superiority of the second gives it a claim to be chosen, but it is less common, and not so easily obtained.

In another vessel of a large surface, and placed on three or more feet in the vessel which contains the spirits, is to be put the muriate of lime, dried and pounded.

This disposition being made, the vessel which holds the spirits is to be closed up completely, or its edges are to be secured with bands of paper pasted over them, and the whole is to be left in this state for four or five days. After this time, the vessel holding the spirits is opened, and that containing the muriate is taken out. This salt is then found to be more or less dissolved, according to the quantity of water which it has attracted. The degree of strength of the spirits is then examined, and it is found to be increased 5, 6, or 8 degrees, according to the fineness of the grain

of the dry muriate; it ought not, however, to be too fine, to prevent its becoming pasty, and to make its surface more extensive; the vessel holding the muriate is then cleaned, a new portion of the dry muriate is spread on it, and it is put back into its place, and then the vessel containing the spirits is again shut up. in the same manner as before the insertion of this second dose of deliquescent salt.

By operating successively in this manner, highly rectified alcohol is obtained, and weak spirits, of 10 or 15 degrees, (of Beaumé's areometer) are raised to 40 or 42 degrees.

It may be conceived that this method may be applied to the concentration of various saline fluids, acids, &c. and that by a particular disposition of the factory, basins, &c. it would be easy to establish a rotation (of the processes,) which, in a given time, would afford, at pleasure, daily products of all degrees of concentration.

M. Decharme is, at present, employed in trying to give to this process, by the aid of mechanism and natural philosophy, all the regularity, precision, and perfection, desirable for a work on a large scale.—[*Annales de Chemie.*

INDIAN RUBBER TUBES.

At a Meeting of the Nottingham Literary and Scientific Society, held on Monday, the 10th October, 1825, a paper, by Mr. H. B. Leeson, describing an improved process of manufacturing Tubes, and other Articles, from Indian rubber, was read, and some tubes so prepared, were handed round, for the inspection of the members.

After pointing out, that all the present processes of manufacturing elastic gum were objectionable, either from the injury they occasion to its elastic properties, or the great expense of the menstrua employed, (such, for instance, as cajeput oil and ether,) the writer proceeded to detail his process.

A bottle of Indian rubber, previously softened by boiling in water, as described by Mr. Leeson, in his paper on the self-acting blow-pipe, inserted in the 17th volume of the Quarterly Journal of Science and Arts, is first to be distended to the utmost possible extent, by means of a condensing syringe. The rubber thus expanded into a uniformly thin layer, is then cut into stripes of the breadth of one or two inches, and wrapped, longitudinally, round polished iron rods, of the same diameter as the bore of the tubes required. The rod has a hole through each end, and a tape being made fast to one hole, it is tightly wrapped, in a spiral manner, over the layer of elastic gum previously applied. The whole is then boiled in water for several hours; and if, when taken out, perfect adhesion has not taken place, it is again wrapped with fresh dry tape, and reboiled until the union is complete. The roughness left upon the external surface of the tube may afterwards be removed, by binding it with a smooth plate of metal, and boiling it

over again. The tubes exhibited to the society were in nowise to be distinguished, in their elasticity, from the bottles met with in commerce, and afforded convincing evidence of the excellence of the process.—[*London Mechanics' Magazine.*

VIENNA GREEN.

The process for making this esteemed colour is thus described by Dr. Liebig, in a communication to the French Society for the Encouragement of the Arts and Sciences:

Dissolve with heat, in a copper boiler, one part of verdigris in a sufficient quantity of pure vinegar, and add an aqueous solution of one part of white arsenic. During the mixture of these liquids, there commonly forms a dirty green precipitate, which, it is necessary, for the beauty of the colour, to make disappear. For this purpose a fresh quantity of vinegar is added, till the precipitate shall be re-dissolved. The mixture is then boiled, and after some time, a granulary crystalline precipitate is formed, of a most beautiful green colour, which, being separated from the liquid, well washed and dried, is nothing else but the green colour in question.

If the liquor still contains an excess of copper, more arsenic is to be added, and if it contains an excess of arsenic, it is necssary to add more copper, operating in other respects in the same manner. It often happens that the liquid contains an excess of ascetic acid; in this case it may be employed anew, for dissolving verdigris.

This colour, thus prepared, has a bluish cast; but, in commerce, a deeper and yellower shade is required, retaining the same brightness and beauty. To produce this change, it will be sufficient to dissolve a pound of the potash of commerce in a sufficient quantity of water, adding to it ten pounds of the colour obtained by the above process, and heating the whole by a moderate fire. The mass soon deepens in tint, and takes the shade required. If it be boiled too long, the colour will incline to Scheele's green, but will always surpass it in beauty and brilliancy. The alkaline liquor, remaining after this treatment, may still serve for preparing Scheele's green.*—[*Ib.*

PREVENTION OF STEAM-BOAT ACCIDENTS.

The disastrous accident which lately befel the Steam-boat Comet, by which upwards of fifty persons lost their lives, has produced the following letter from Captain Basil Hall, on the means of guarding against such fatal occurrences in future. It deserves an attentive consideration, as coming from a Gentleman whose science and nautical skill confer a high value on his authority.

* Scheele's green is a combination of deutoxide of arsenic and deutoxide of copper.

"In reply to your questions, respecting the best method of guarding against such fatal accidents as that which lately befel the *Comet* steam-boat, I beg leave to state one or two precautions, which I think would give great additional security to steam navigation.

"In the first place, every steam-vessel ought to carry a light in her bow; and this ought not to be a mere lanthorn, made fast to the gunwale, or tied to the rigging; but should be fixed in midships, on the top of a pillar raised seven or eight feet above the deck, so that the light might not be interrupted by any one standing before it. The light itself ought to consist of two lamps, with reflectors in separate compartments, in case of one blowing out while trimming. This lanthorn, or light-house, should be made of strong glass, and rendered water-tight, so that the spray, or rain, might not extinguish the lights in bad weather. It would be of consequence that these lights, in all steam-vessels, were made of the same size and height, and carefully screened towards the stern, to prevent mistakes.

"A regulation ought, in the next place, to be universally established, similar to that used in the Clyde, by which two steam-vessels, when meeting, should observe the same law as coaches, and invariably take the left hand.

"One look-out man ought to be stationed in the bow, who should always be a seaman, capable not only of calling out to the steersman of his own vessel, which way to put the helm, but competent also to hail other vessels, to give the requisite information for their guidance.

"It is absolutely essential, in the next place, I conceive, to the safety of steam-vessels, that no jibs, or other head sails, should be carried after sun-set. These sails not only intercept the light, but prevent the look-out man from distinguishing objects a-head, and in all cases of rencontre are very perplexing to both parties. If this important regulation were established, one look-out man would be much better than two, as all embarrassment arising from contradictory orders would be avoided. In sailing vessels it is different; they cannot do without head-sails, and one look-out man on each side, is, consequently, indispensable.

"It is much to be wished, that every steam-vessel were fitted with the admirable contrivance, invented by Messrs. Carmichael, engineers, of Dundee, by which the machinery of the engine is so regulated, that, by the mere turning of a handle on deck, the vessel may be made to go a-head or a-stern, or may be suddenly stopped, at pleasure. This contrivance is so simple and obvious, that it may be used, under directions from the captain, by the most ignorant passenger, as effectually as by the most skilful engineer. A dial-plate, with a hand, like that of a clock, points out what is to be done, and a turn of a lever, backwards or forwards, performs the whole work, without the necessity of calling out to the engineer below, and thus the machinery is as completely under the control of the master, as is the rudder.

"In some steam-vessels the tiller ropes are absurdly led cross-

wise, in such a way, that when the wheel is turned as on board ship, a different effect is produced on the rudder. This is done to save the ropes from chaffing, or some such petty object; but it is in the highest degree mischievous—as in a case of danger or difficulty, any seaman recently shipped on board, who should seize hold of the wheel, would inevitably turn it the wrong way, and instead of steering the vessel clear of an obstacle, go directly against it.

"I remain, &c.

"BASIL HALL." [*Ib.*

NOTICE.

The Editor is preparing several articles, on subjects interesting to the Mechanic; such as the different methods of cutting screws; the preparation and use of varnishes and lackers, of different kinds; the various modes of boring and drilling; the preparation and casting of plaster, and other materials, &c. &c. It is his wish to embody the most important information on these subjects, so as to render a reference to them more easy than it would be, were the different articles related to each other, to be found only in detached pieces, spread over the whole Journal. Mechanics, and others, possessed of practical information on these, or any subject, relating to the useful arts, are again most earnestly solicited, to assist the Editor in the performance of this task. The work is designed to aid practical men; a class to which the philosopher is indebted for whatever is true in theory, and the arts for nearly every thing that is correct in practice.

It has not been in the power of the Editor, to arrange the materials of this number, under their respective heads; and the experience of the past month, will not warrant him in promising to accomplish this object in the next. His transition from a busy and anxious employment, differing altogether from his present pursuits, has been too sudden to admit of his bringing his own mind into that kind of training which he feels to be necessary to himself. The printer, the engraver, and others, also, require some time, to enable them to march with regularity. The next Number will issue as early as possible.

IMPORTANT WORK.

It is the Intention of the PENNSYLVANIA SOCIETY FOR THE PROMOTION OF INTERNAL IMPROVEMENTS, *to publish, by subscription, Mr. Strickland's Reports on* CANALS, RAILWAYS, TURNPIKES, MANUFACTURE OF IRON, STEEL, COKE, OIL, AND COAL GAS.

It is supposed that the Legislature of the State, and the Congress of the United States, will subscribe for a certain number of copies, with the view of encouraging the work.

It will contain eighty engraved folio plates, and will be sold for the actual cost.—The Prospectus will appear in our next Number.

THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE MECHANIC ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

FEBRUARY, 1826.

The following are the Standing Committees of the Franklin Institute, for the year 1826.

On Finance.

Paul Beck, jr.
James M'Alpin
J. Harper
A. G. Ralston
John Richardson

On Instruction.

R. M. Patterson
James Ronaldson
Isaac B. Garrigues
A. G. Ralston
S. V. Merrick

On the Library.

Mathew Carey
Harvey Lewis
Lloyd Mifflin
W. S. Warder
H. J. Reihle

On Models.

John Haviland
James Clark
Lloyd Mifflin
I. B. Garrigues
Rufus Tyler

On Minerals.

P. A. Browne
William H. Keating
John Harrison
Abraham Miller
Thomas P. Jones

On Premiums and Exhibitions.

James Ronaldson
Adam Ramage
Thomas Fletcher
Samuel V. Merrick
William Strickland

On Inventions.

R. M. Patterson
James Ronaldson
James J. Rush
Samuel Humphreys
Thomas P. Jones

On the Hall.

Harvey Lewis
William S. Warder

On Publications.

Mathew Carey
William H. Keating
Thomas P. Jones

FOR THE FRANKLIN JOURNAL.

Observations on the Rise and Progress of the Franklin Institute.

Communities, as well as individuals, may all be said to have their attention and interests excited towards the attainment of certain objects, which, either from chance, inclination, or caprice, they chiefly affect. These hobbies, if we may be permitted the term, acquire more importance when they are supported by numerous individuals, than when forming the object of the hopes and wishes of a single one. Like the favourite schemes, which at various periods of his short life, prompt man to the pursuit of particular objects in preference to all others; so the projects which occasionally start up in Societies, and enlist in their support the talents, exertions and wealth of their members, have been found to vary according to the spirit of the age. New plans have succeeded each other with almost inconceivable rapidity; a few alone subsisting after the excitement to which they owed their birth had worn away, have survived their short-lived projectors; and descending from generation to generation, have acquired an importance proportioned to the lapse of ages through which they have passed. Foremost among these, may doubtless be ranked, the various establishments instituted for the promotion and dissemination of learning. Science and the Arts did not at first attract, as they deserved, the attention of the wealthy and the noble. By them, education was, for a while, despised, as alone becoming the inferior classes of society; and it was deemed the distinctive badge of opulence and high birth, to be among the most ignorant of the land. But when, in the successive political revolutions, which assisted in the progress of those principles of popular representation, upon which all modern governments are founded, it was proved that in-

fluence was the necessary consequence of literary acquirements; that, in the emphatic words of Bacon, knowledge was power; when the experience of the age had made this maxim so evident as to bring conviction home to the minds of the most sceptical, then they who had until that time monopolized all power, found it convenient to extend their views, and to attempt to confine knowledge also within the reach of themselves and their equals. No longer affecting to despise it, they pretended to discover in it something of so insidious a tendency that it could not be imparted to the commonalty without danger to the state; and hence, the literary institutions which, till then, had been fostered by ecclesiastical zeal alone, became endowed by the nobility, while their constitution and laws were re-modelled, with a view to render them difficult of access to any but the privileged orders. The same aristocracy that had for ages monopolized power, honour, and profit, now extended its arms to embrace within its grasp, learning also.

The many changes which have occurred during the last seventy years, have, however, tended altogether to subvert those restrictions, and to place education within the reach of all, whether born in affluence or poverty; whether destined to inherit boundless wealth, or to support themselves by the sweat of their brow. The change was not, however, a sudden one; even the most enthusiastic advocates of popular education, dared not at first to extend their request beyond those rudiments which were necessary for the acquisition of a religious and moral education. That the poor should be instructed in reading and writing, in order that they might be enabled to peruse the sacred scriptures, and to read in the book of wisdom, those maxims intended for the good of all, was a request so reasonable, that it could not but be granted, in spite of the accumulated prejudices of the age. When these had been attained, it was thought desirable to extend these benefits still further; the friends of universal education felt themselves emboldened by the success of their first measures. They had demonstrated that the poor could be instructed, and that no evil consequences would result therefrom to the state. The number of their partizans grew daily more considerable, and the extension and dissemination of education by gratuitous schools, became, by the recent improvements introduced into the art of instruction, an easier task than had been anticipated. Still, many difficulties were met with, one of which arose from the very apathy of those who were to be benefitted by it, holding in contempt, that which they could not understand—they at first objected to submit to the course of intellectual improvement, which was so liberally placed within their reach. Blinded in a few instances, by an unpardonable eagerness after small pecuniary gains, they refused to their children those opportunities of improvement, which would curtail, somewhat, their hours of daily labour. No one can too highly deprecate the infatuation which prevented them from discovering, that the seed of knowledge early implanted in the breast of their children, could not palsy their future efforts, and incapacitate them for la-

borious exertions, but that, on the contrary, by making a call upon the active exertions of the intellectual powers, it would stimulate them, and cause them to assume that development, which would subsequently support the adult individual, in all those difficulties which, in his progress through life, he would have to encounter. From this unfortunate apathy on the part of many, it soon appeared that the education which was thus extended to them gratuitously, became from this very circumstance, of less value. It was held cheap and of no account, because it cost nothing. The attendance upon the schools became irregular, the progress of the pupils was consequently less rapid, and the system itself necessarily fell into disrepute.

We are not able to decide from the information before us, to whom we are indebted for the first great improvement subsequently introduced into education; and which consisted in making the parent contribute somewhat to the instruction of his children. The contribution was so small that it was not beyond the reach of the poorest citizen, that was endowed with even but common industry and common talents; yet it was such, as having been once paid, stamped a certain value upon that education, to which it gave access. He that after having paid for it, did not insist upon his children's punctual attendance upon the schools, felt as if he had suffered himself to be defrauded of his acquired rights, as if he had made an unnecessary sacrifice of his own interest.

The plan is unquestionably of Scotch origin, and we can refer it to the system of parochial schools, so long established in the Highlands of Scotland, and which has secured to the inhabitants of that country, the claim which they justly assert, to rank first among the universally instructed nations of christendom. It has enabled more men of talents among them to start from the common ranks of life, and, by an assiduous and zealous pursuit of learning, to place themselves on a par with the proud aristocracy of their country, and to hold the highest ranks in all departments, whether of science, letters, politics, or the arts. To these early principles of education, which the Scottish cottager imbibes from his tenderest years, as much perhaps, as to national peculiarity, are we to attribute the uniformly prudent, cautious and virtuous character, which has always distinguished the Scotchman through his numerous migrations, and imparted to him the means of thriving in whatever situation chance may have placed him.

Whether, as has been generally believed, the late Dr. Anderson of Glasgow, was the first, who, by his liberal provisions in favour of the Institution, which bears his name, gave a new stimulus to this zeal for public instruction, and excited the mechanics of his large manufacturing town to the acquirement of the general principles of science; or if he only laid, as has since been alleged, the foundation of an Institution which, in its successful efforts to promote the welfare of the labouring classes of the community, suggested to others the plan of the Mechanics' Institutions, of which so many have of late been created, is a question which we do not

choose to discuss. Which ever side may be adopted, it cannot be denied that Anderson's name will descend to posterity, as that of one of the greatest benefactors of the human family; and that the good of which he will have been the direct or indirect cause, will bear an advantageous comparison, with that produced by any other person, whose name stands recorded in History.

Twenty years and more, did the Andersonian Institution continue to extend its useful instruction to all classes, without distinction, when a zealous friend to the same cause arose in the person of Dr. Birkbeck, who, by the establishment of an Institution in Glasgow, and of one in London, made the benefits of this system of popular instruction in science, still better known. Various other societies sprung up about the same time, and the number of Mechanics' Institutions is, at this moment, increasing so rapidly, that we doubt not that ere long, a similar society will be considered indispensable in all large cities. Justice requires us to state, that even before Dr. Birkbeck had invited the attention of the Mechanics of London to this subject, and it is even said, prior to the formation of any association of Mechanics for mutual instruction in Europe, a public spirited gentleman of New York, advantageously known by his scientific and literary publications, as well as by his success in popular lecturing, resolved upon an attempt to unite the Mechanics of his flourishing city, into an institution whose object should be the promotion of the Mechanic Arts, by lectures and by other judicious measures.

It cannot be believed that, in the city of Philadelphia, where so many enlightened and industrious mechanics are daily seen accumulating large fortunes, any backwardness should have existed as to the formation of a similar institution. Nor can it be believed, that in the city where a society of that kind once existed, supported by the names of Franklin, Godfrey and others, that any great difficulty should have existed in realizing so desirable a scheme. We have been told that it was contemplated many years since, by a distinguished gentleman of this city whose efforts were either discontinued or proved unsuccessful, from what cause we know not.

In the mean while, many of our citizens had been made acquainted with the importance of the object, and had become anxious for the attainment of it. A meeting of a few gentlemen, we believe about fifteen, was held at a private house in this city, in the beginning of November, 1822. The subject was fully discussed, and uniting the approbation of all, was referred to a committee to devise means to carry it into operation. Many societies have been originated in our city at various times, all apparently deserving of support, but unfortunately many of them, from various causes, have enjoyed but an ephemeral existence; this has created a prejudice which operates against every new institution, and which tends to damp the courage of those who are not steeled against disappointments. With many persons, so prejudiced, the committee came into contact, and a doubt of the practicability of the plan having been started, it was suggested as a means of insuring its success, to

abandon the hope of forming a new society, but to endeavour to engraft the views of the committee upon a respectable institution, already in full operation in this city, and which was supposed to have a considerable fund at its disposal, exceeding its present means of employing it. Unwilling to risk the great objects which they all had at heart, by too pertinacious an adherence to their original plan, the committee entered into a negotiation which was protracted throughout the winter, and which eventually failed. It was at last, found that no assistance could be expected from the old institution, many of whose members entertained serious doubts as to the legality, or even expediency, of any measures tending to change their accustomed objects of support. In the mean while, procrastination was attended as usual with languor—several of the members dispersed—the winter, which is the best season for active exertions of this kind, having been allowed to pass away, the plan was finally dropped. We deem it, however, fair to state, that from peculiar circumstances, the committee had not been able to confer with many of the practical men of our city; from the spirit which they subsequently manifested, no doubt can exist that they would at that time have extended their support to the proposed institution, as readily as they have since done.

The plan having been abandoned by the projectors of 1822, it appears that a similar one was devised by a number of gentlemen entirely unconnected with the former. After sundry unsuccessful attempts to form a meeting for this purpose, a small one was held at the Hall of the American Philosophical Society on the 9th day of December, 1823. The minutes of this meeting, which was considered as the first of the Institution, under whose patronage this Journal is now issued, do not inform us how many persons were present at that time, but we have been told upon good authority, that there were not more than five. From this small beginning, then, did the Franklin Institute arise. A coalition had by this time taken place between the projectors of 1822 and those of 1823; and these, together with many others, who had promised their aid and support, soon satisfied the few members present, that their forces would be multiplied a hundred fold, as soon as their plan should be fairly before the public.

At the meeting of the 9th of December 1823, a committee of seven gentlemen was appointed to prepare the draft of a constitution, and such other papers as might be necessary to lay before an adjourned meeting, to be held at such time as they might appoint, and to which they were authorized to invite such persons as they might deem friendly to the scheme.

This committee held several meetings, and after having adopted the best measures which, with the assistance of their friends, they could devise, for the establishment of the institution, it became a subject of serious consideration with them, in what manner the plan should be brought openly before the public. Two different methods have been chiefly resorted to in this city in similar undertakings; the first consists in digesting the matter at small private meetings,

adopting a constitution, selecting the first board of officers, and then endeavouring to enlarge the society by the exertions of the framers, and of the board. The second plan is to bring the matter immediately before a public meeting, and to entrust to that meeting the initiatory steps, as well as the subsequent success of the scheme. Both these methods have their advocates, and are supported by plausible reasons. The latter course, is unquestionably the most open and candid, and if nothing interfere to distract the meeting, it is that most likely to prove successful in the end. But those who are conversant with public meetings, know that frequently the efforts of the real friends to a measure of public good, are frustrated by insidious attempts from persons whose sole design seems to be to thwart every thing that they have not themselves devised, or that leads not to their personal aggrandizement. Notwithstanding these objections, the full force of which was felt by the members of the committee, they unanimously resolved to risk this attempt. The failure produced in the preceding year by the lukewarmness resulting from delays, convinced them that it was only by striking a decisive blow, that the popularity of the object could be tested. Being vested with the power to convene an adjourned meeting, and to invite to it as many persons as they pleased, they resolved upon extending the invitation to all the inhabitants of the city and county, friendly to the promotion of the arts, and accordingly called a town-meeting for Thursday the 5th of February, 1824, at the County Court House: in order to insure a general attendance, they issued a large number of circulars, and addressed one to every person whose name was suggested to them as likely to benefit the cause. The meeting was a very large one, and it was evidently formed of the very persons whose attendance was chiefly desirable. The circumstances under which they were convened, the views of the committee in extending the invitation to all the citizens of the county, and in laying the matter fairly and publicly before them, prior to the adoption of the Constitution, or to the selection of the officers, were fully stated to the meeting.

A number of resolutions which had been prepared by the committee, were presented and severally adopted, after a discussion which showed the disposition of the meeting to act advisedly upon the subject. The draft of a constitution was then submitted, and after various amendments, the usefulness of many of which has since been fully tested by experience, the several articles were separately adopted, and after having passed several resolutions relative to the first election for officers, which was ordered to take place on the 16th of the same month, the meeting adjourned.

[TO BE CONTINUED.]

Society for promotion of Internal Improvements.

In the last number of the Journal, we proposed to furnish in this, an abstract of the Instructions given to Mr. Strickland, by

the Society for the promotion of Internal Improvements. We have since determined to publish the paper entire. Our readers will thus be able to form some estimation of the value of the materials contained in this gentleman's reports, which the Society is about to publish. A work which, for practical utility upon the subjects which it embraces, will be found to be without an archetype in any language.

Mr. Strickland's Instructions.

Philadelphia, March 18, 1825.

William Strickland, Esq.

Dear Sir—The Acting Committee of "The Pennsylvania Society for the Promotion of Internal Improvements," beg leave to call your attention to the general outlines of the duties you will have to perform, as the agent of the Society in Europe.

The objects, for the attainment of which the Society have determined upon this measure, the execution of which is delegated to you, are known to you, and you will constantly have in view their accomplishment with your best abilities. The confidence we place in your talents and industry, the obligations you will be under to obtain, for the heavy expenses attendant on your agency, an adequate return; and the satisfaction, as well as the rewards you will yourself have in contributing, by the success of your labours, to the prosperity, wealth, and happiness of your native state, and of your country, are ample pledges of the fidelity and diligence with which you will execute the duties of the important trust.

You will proceed from this city to Liverpool, taking your passage in one of the line of packets from this port, and commencing your voyage within the present month.

As *England*, *Scotland*, *Wales*, and *Ireland*, have made more progress in the arts and sciences, and have more extensively and successfully applied them to internal improvements, your observations, inquiries, and investigations will, in the first portion of the time you will be absent, be directed to the great works which have been accomplished in those countries. You will afterwards proceed to *France*, *Holland*, and *Germany*, should any objects of sufficient interest exist there, and time shall permit the same. Thus we desire it to be distinctly understood, that you will visit no other parts of Europe, unless further instructed, than England, Scotland, Wales, Ireland, France, Holland, and Germany.

As a general principle which shall govern you in all your proceedings, and as the leading purpose in all your pursuits, we wish you to understand, distinctly, that all the knowledge and information you can collect, all the facts which you shall become possessed of, which may in any manner be connected with your mission, must be carefully, accurately, and minutely written down and preserved in the form of a diary, or such other record as will enable you to communicate the same to the Society, in memoirs or reports, when your duties shall enjoin the same. All the results of your inquiries and exertions will be the property of the Society.

Another and equally important rule, which we wish you to observe and faithfully execute, is the following.

It is not a knowledge of abstract principles, nor an indefinite and general account of their application to the great works of Europe, we desire to possess through your labours. These we have in books, and your mission would be of little comparative value, should you acquire for the Society such information only. What we earnestly wish to obtain, is the means of executing all those works in the best manner, and with the greatest economy and certainty; and for these purposes you will procure and exhibit in your reports, all that will enable those who shall undertake the formation of *Canals*, *Railways*, and *Roads*, and the construction of *Bridges*, to perform the work, without such persons having the science by which such works were originally planned and executed. To use a term which is familiar to you as an architect, we desire to obtain *working plans* of the best constructed canals, and their locks and inclined planes; of railways, and all the means of using them to advantage; of *roads*, and of the mode of their formation and preservation; and of the construction of *bridges*. To be more definite on this head, we desire that you furnish such minute and particular descriptions, plans, drawings, sections, estimates and directions, as possessed of them, those works may be executed in Pennsylvania, without the superintendence of a civil engineer of superior skill and science.

Before we proceed to a particular statement of the subjects for your investigations on your mission, we would claim your attention to a pledge which has been given by the Society to the public; that your first efforts shall be directed to *railways*, and that at as early a period as possible, you shall communicate all the information you can collect upon them.

Canals. In your examination of the canals of Europe, we request you will always bear in mind the fact, that the great capital which is ever at the command of those who there undertake such works, and the immediate and profitable use to which they can be applied, have induced those who have executed them, to regard their cost of less importance than we are compelled to consider it here. When a work of that kind will produce returns of three or four times the rate of interest in the country where it is executed, expenditure is of less consequence than with us, where the pecuniary means to accomplish any such purposes are collected with great difficulty, and where attempts to execute them frequently fail from a want of capital. Whatever may be the certainty of ultimate profit from any of our canals or roads, we have always found obstacles to obtaining funds for their prompt execution. In the differences between the cost of labour in England and Scotland, and in America; the cheapness of some of the materials used in the construction of their public works, and in the facilities of transporting those materials which the improved state of the country, and the existence of canals and railways in the vicinity afford, may be found many important facts which have materially influ-

enced the cost of those works; on the other hand, we have materials, which may not have been used there on account of their scarcity and expense, and which if substituted in our undertakings, would materially diminish our expenditures in the formation of canals, with their locks, and inclined planes. Thus *wood* is in England a most costly article, and hence stone is there generally substituted. If wood could be used in the construction of the *locks* of canals, more than two-thirds of their expense would be saved, and the execution of many works of this description, in our country, would be certain.

With these introductory remarks, which are submitted to your candid consideration, we proceed to say, that you will, in reference to *canals*, inquire and report to the Society upon, 1st. The most approved and substantial method of constructing *Lock Gates*, together with their *valves* and sluices.

2nd. The best mode of lining and *puddling Aqueducts and Culverts.*

3d. The best plan for overcoming the difficulty in forming the bottom and side banks of a canal, through limestone formations; or formations which are cavernous, porous, or soluble in water; particularly in deep cutting, and in embanking.

4th. The cost of the work by the cubic yard, stating the particular quality and parts thereof.

5th. The failures in canals; their causes; and other circumstances connected therewith.

6th. Rock excavation; tunnelling generally, and through *gravel and other loose soil;* the use and frequency of *shafts;* together with the best method of removing the materials, and draining the work in its progress: the greatest depth of shafts, and how preserved and constructed?

7th. The quantum of *evaporation* and *soakage*, particularly considered; reference being made to the *locations, soil,* and *quality* of the work.

We also request your attention to the following queries, which relate to canals, or subjects connected with their use.

8th. Is there any substitute for locks, now in use in England, or on the continent? If so, what advantages have they been found to possess?

9th. Is there any information in England concerning the evaporation of water occasioned in canals by variations of climate? The great mining districts of Germany, furnish some very curious results as to the evaporation by high winds in the autumn and winter season.

Perhaps the canals of the south of France may afford some facts on the solar evaporation, in summer. Our climate is so different from that of England, that we must endeavour to obtain *data* on this subject from the continent.

10th. Are steam boats permitted to navigate any of the canals in Great Britain? If any, what means have been devised to prevent the destruction of the banks, produced by the motion imparted to the water?

11th. Are any of the tunnels in England made through crumbling rocks? if so, what arch is preferred for their protection? is there any case where a complete elipsis has been required, as in mines?

12th. If a rock is not to be obtained for a foundation for the lock walls, do they in every instance pile, or construct inverted arches, upon which to build their walls; or do they, when they have good gravel or slate, rely upon it for a foundation? If not, may not timber laid lengthways be relied on? When they have not rock for the bottom of their locks, do they make an artificial bottom of stone or wood?

13th. Do they build their lock walls in straight or curvilinear lines? What is the thickness of their lock walls, and are they supported by buttresses extending into the banks? or by giving the walls a greater thickness, do they supersede the necessity for buttresses? How are their lock walls built—if of cut stone in front, how is the backing constructed—whether of common rough mason work, or of large stone well fitted together? What is the best kind of cement, and how is it affected by the seasons? How soon does it perish?

14th. What is the slope of the banks of a canal? What the height of the banks above the surface of the water, particularly the towing path side, and its width?

15th. In very deep shafts, are the workmen affected by the gases from the bowels of the earth? Is there an instance of the workmen being driven off by the gases? What proportion does the diameter of the shafts, bear to their depth? What distance are shafts apart, and is not this regulated by the depth of digging, or height of the hill? What is the greatest depth a shaft may be sunk?

16th. What kind of river navigation have they above the tide? How is the navigation constructed? What kind of towing paths have they? What distance are they from the boat channel; and when the distance between them is very great, is the power for propelling the boat necessarily very much increased? If so, is it in direct proportion to the distance?

17th. What kind of gates have they across the towing paths, where they pass through different enclosures?

18th. In the severe weather in the winter, do they draw the water off their canals?

19th. Have the frosts of winter any pernicious effect upon their canals, locks, turnpikes, and rail-roads?

20th. What descent have their canals, or what is the approved descent? What is the greatest acclivity of rail-roads?

Mr. John Blair, of our state, whose communications to the Society have always been valuable, has expressed a wish that you should inquire, whether wooden locks are in use, what length of time they will last, and what is the comparative expense between them and stone locks? He remarks, and justly, that as our western canals must have the greatest portion of their lockage in, and near the

mountains, where there are inexhaustible forests of timber, should timber be useful, and the durability of such locks considerable, a great saving would be effected. This subject is placed in a very interesting position by a letter of Mr. Sellers, which we request you will peruse. Like the early settlements of our country, we may find it advantageous to be simple and homely in our first works, and in time, replace them by others of a superior execution, and of permanent materials.

Railways.—Of the utility of railways, and their importance as means of transporting *large burdens*, we have full knowledge. Of the *mode* of constructing them, and of their cost; nothing is known with certainty. Even in England, where *railways* have been used for more than a century, these are subjects of controversy and doubt. You will arrive at Liverpool at a peculiarly fortunate era in the construction and employment of railways. The great communication by their means, between Manchester and Liverpool, and between Birmingham and Liverpool, will have been commenced; or all the principles and plans, by which they will be governed in their construction, will have been settled and determined.

We desire that your inquiries in relation to *railways* shall be commenced and prosecuted as soon as you arrive; and that as speedily as you shall have obtained all the information upon them you deem important and sufficient, that you transmit the same to us; retaining a duplicate of your report, and of the drawings and estimates which may accompany it for illustration.

You will bear in mind, in your investigations of this subject, that we have, as yet, no complete railway in Pennsylvania; and you will therefore so exhibit your facts, as that they may be understood by reference to the drawings which you may make, and which shall accompany your report.

Commencing in your examinations with the plans observed in making surveys and forming the line of the route of the railway; it is desired that you ascertain with precision the greatest angles of ascent which the profitable use of railways will bear. In our mountainous state, if railways shall be adopted, they must pass over numerous elevations, some of them abrupt, and many of them so formed as to render their reduction impossible.

The *foundations* for the reception of the iron rail will next require attention. Climate must enter materially into the decision upon the question, how the foundation of a railway shall be made in Pennsylvania; and the differences between the moist and moderate winters of England, and the deep snows, sudden and hard frosts, variable temperature, and long continuance of our winters, must have your consideration and attention in these examinations. Without entering into the subject particularly, but submitting it, with great deference, to your consideration, we would remark, that if masonry could be avoided in the construction of the foundation for the iron rails; if wood, however large in size, and great in quantity can be employed here, the influence of our climate upon the

work would be less injurious. Durability of the materials would be lost by the use of wood, but the parts might retain their form and connexion for a long time, and the small expense of replacing any part of the work which might decay, would perhaps compensate for the absence of permanent substances in the foundation. In relation to the construction and form of the road and rails, we desire you to ascertain every mode which is now in favourable use in England, Scotland, and Wales. It is said that recent improvements have been made in the form and position of the rails; and that different forms are used for different purposes. How railways are crossed by wagons heavily laden, how wagons pass when proceeding in opposite directions, what means are taken for the protection of railways from injury by wheels not properly constructed to pass upon them, and how the wagons and their carriages are constructed, and of what materials? Upon all these subjects we ask particular information, accompanied with drawings which will make the same easily understood and employed.

The *expense* of railways will be a subject of careful and particular investigation. In your statements under this head you will inform us of the separate cost of each part; distinguishing accurately between the charges for the formation of the line, and the preparation of the foundation, and the expense of the materials employed. The difference between the cost of labour in England and in this country, will affect these statements; and it would therefore be well, if you would accompany your report with information of the rates of day labour, in the particular parts of the country where the railways are located, which may be referred to by you.

Locomotive machinery will command your attention and inquiry. This is entirely unknown in the United States, and we authorize you to procure a model of the most approved locomotive machine, at the expense of the Society.

[TO BE CONCLUDED IN OUR NEXT.]

FROM THE LONDON TIMES.

PERKINS' STEAM GUN.

The neighbourhood of Mr. Perkins' safety steam engine manufactory near the Regent's Park, was on Tuesday thrown into great consternation by some tremendous reports, arising from the discharge of his steam gun. Since a fatal accident, which occurred several months ago, where a lady threw herself from a gig, in consequence, as it was at the time incorrectly supposed, of her horse having taken fright at the prodigious noise made by the steam gun, the terrific engine of destruction had not been permitted to be discharged by the individuals belonging to Mr. Perkins' concern. On Tuesday morning, however, soon after eight o'clock, patroles were observed stationed on all the roads leading towards the manufactory, accompanied by men with placards on boards, warning all

passengers on horseback or in carriages, to go through the Regent's Park, instead of proceeding by the high road leading in front of the manufactory.—Soon after nine, numbers of military officers, in carriages and on horseback, alighted at the manufactory. They were soon followed by the Duke of Wellington; and immediately afterwards the discharge of steam, which had been previously occasional, and of comparatively slight force, commenced with a continued roar, resembling the loudest thunder we ever heard. The group of eminent persons then assembled, consisted of his Grace, the Master General of the Ordnance, and his Staff, the Marquis of Salisbury, Mr. Pell, Sir H. Hardinge, Lord Fitzroy Somerset, the Judge Advocate General, and many military officers of the highest rank; together with a Committee of Artillery and Engineer Officers, who, it appeared, had been officially appointed by the Duke of Wellington to examine into the merits of this wonderful specimen of human ingenuity and destructive power. The discharge of steam now became almost incessant for two hours; during which, its incalculable force and astonishing rapidity in discharging balls, excited amazement and admiration in all present. At first the balls were discharged at short intervals, in imitation of artillery, firing against an iron target at the distance of 35 yards. Such was the force with which they were driven, that they were completely shattered to atoms. In the next experiment, the balls were discharged at a frame of wood, and they actually passed through 11 one inch planks of the hardest deal, placed at a distance of an inch from each other. Afterwards they were propelled against an iron plate one fourth of an inch thick, and at the very first trial, the ball passed through it. On all hands, this was declared to be the utmost effort of force that gunpowder could exert. Indeed, we understand that this plate had been brought especially from Woolwich, for the purpose of ascertaining the comparative force of steam and gunpowder. The pressure of steam employed to effect this wonderful force, we learnt, on inquiry, did not at first exceed 65 atmospheres, or 900lbs. to the square inch; and it was repeatedly stated by Mr. Perkins, that the pressure might be carried even to 200 atmospheres with perfect safety. Mr. Perkins then proceeded to demonstrate the rapidity with which musket balls might be projected by its agency. To effect this he screwed on to the gun barrel, a tube filled with balls, which, falling down by their own gravity into the barrel, were projected, one by one, with such extraordinary velocity, as to demonstrate, that by means of a succession of tubes filled with balls, fixed in a wheel, (a model of which was exhibited,) nearly one thousand balls per minute might be discharged. In subsequent discharges or volleys, the barrel, to which is attached a moveable joint, was given a lateral direction, and the balls perforated a plank nearly twelve feet in length. Thus, if opposed to a regiment in line, the steam gun might be made to act from one of its extremities to the other. A similar plank was afterwards placed in a perpendicular position, and in like manner, there was a stream of shot holes from the top to the bottom. It is thus proved

that the steam gun has not only the force of gunpowder, but also admits of any direction being given to it. But what seemed to create most surprise, was the effects of a volley of balls discharged against the brick wall by the side of the target. They absolutely dug a hole of considerable dimensions in the wall, and penetrated almost one half through its thickness. We heard several officers declare their belief, that, had the balls been made of iron instead of lead, they would have actually made a breach through it—the wall was 19 inches thick.

ON IRON AND STEEL. BY THOMAS GILL.—No. 2.

On hardening and tempering cast steel.

Various compositions are used for this purpose, according to the nature of the articles to be hardened and tempered. For saws of the usual description, and springs in general, the following is an excellent hardening and tempering liquid; viz.

Twenty gallons of spermaceti oil;
Twenty pounds of beef-suet, rendered;
One gallon of neat's-foot oil;
One pound of pitch;
Three pounds of black resin.

These two last articles must be previously melted together, and then added to the other ingredients; when the whole must be heated in a proper iron vessel, with a close cover fitted to it, until all the moisture is entirely evaporated, and the composition will take fire, on a flaming body being presented to its surface; but which must be instantly extinguished again, by putting on the cover of the vessel.

The cast steel articles, if *thin* or *slender*, may be quenched in this composition, in order to harden them; and then be blazed off, as the operation is termed, over a clear fire, in order to temper them. If the articles are *thick*, such as sword-blades, &c. they should be previously hardened, by quenching them in rain-water: and then be tempered, by wiping them over, on both sides, with a thin coating of the tempering liquid, applied by means of a round hard brush, and then blazed off.

On making cast steel exceedingly hard.

By the following process, cast steel may be made exceedingly hard: and we have reason to believe that the celebrated files made by Raoule of Paris, which will act upon or abrade most of the English files, owe their hardness to a similar operation. We know, also, that thin back-saws, or slit-saws, awls, and cock-heels, of an extraordinary degree of hardness, are so made.—The following is the hardening liquor:

Two pounds of mutton-suet, *not rendered*, but only chopped small;
Two pounds of hog's-lard;
Two ounces of white arsenic, powdered.

These, being put into an iron vessel, with a cover fitted to it, must be boiled, until a handful of *Mouse-ear*,* fresh gathered, and which had been put into the mixture at first, shall become crisp, and float on the surface of the liquor;—a proof that all moisture is driven off. This operation, as well as that of quenching any article in it, in order to harden it, must be performed under the hood of a smith's forge-hearth, so as to carry off as much as possible the noxious arsenical fumes which arise; and the operator ought also to cover his mouth and nostrils, to prevent his inhaling them. In using this compound, it must be previously melted: and in order not to overheat the thin or small articles to be hardened, it is well to heat them upon a bar of iron previously made red-hot, and, when of a due temperature, to drop them into the liquor. The workshop will, in spite of these precautions, become more or less filled with dense arsenical fumes;—a proof that much of the arsenic must have been dissolved in the hardening liquor; and some of it, no doubt, enters into union with the steel quenched in it, so as to produce such an extraordinary degree of hardness therein.

The instructions already given, for selecting the *hardest* cast steel, of which these articles are to be made, must be particularly attended to; and the greatest care must also be taken in avoiding all excess of heat in forging and hardening them, in order to ensure the good effects of the process.

On setting steel articles straight which have warped in hardening.

This must be done whilst the articles are as hot as their tempering heat will permit: and is effected, either by means of two strong iron forks, one fixed securely in an anvil block, and the other in a handle, in order to get out warps or twists sideways; or by smart blows with a hammer on the hollow side, the other side resting on an anvil previously strewed over with sand, to prevent the article from slipping away, to get out bends in it: or, otherwise, if the article be slender, such as a file, graver, &c. it may be done by brightening the concave side, and heating it, by pressing it with another proper tool, upon the convex surface of a red-hot iron heater, securely held in a bench-vice, the article being held by one end in the tongs or hand-vices; when it will easily yield to the force impressed upon it when heated; and it may be seen, by the colour it has assumed on the brightened surface, when it has nearly attained its tempering heat. Slender files may be previously dipped into a mixture of olive-oil and spirits of turpentine, and may be safely heated as above, till the mixture begins to smoke. Sword-blades, and other articles in the *ground* state, may be heated to nearly a blue colour, over a cinder fire; and, whilst hot, be struck on a soft anvil, with a hammer made of tin, to avoid bruising them: and if *glazed* also, the blue colour may be removed, by a weak mixture of muriatic acid and water being wiped over them, without staining them much, the acid acting only on the oxided surface.

* *Hieracium Pilosella.*—See Curtis's Flora Londinensis, 53, Fas. 3.

NOTE BY THE EDITOR.—The practice of blazing off, mentioned in the preceding article, is known to most of our workmen; the object generally, is to reduce hardened steel to a spring temper; to effect this, it is covered with oil, tallow, or some other combustible, which when warm will flow over every part; the steel is then held over the fire, moving it so as to heat it regularly, until the grease flames and burns off. It must be evident that it is by no means a matter of indifference, what oily, fat, or resinous substance is used; when a high spring temper is required, this will be obtained by such as burn the most readily, whilst those which require a higher degree of heat for their combustion, will reduce the temper in a proportionate degree. Both the nature of the steel, and the degree of reduction of temper required, ought to be taken into the account.

There is another mode of giving the spring temper, without the use of grease, and without brightening to observe the colour. The spring is hardened in the usual way, and then held over the fire; a small piece of wood is occasionally rubbed over it, which will exhibit sparks of fire, when the steel is sufficiently heated; a good spring temper may be thus obtained; and this also may be varied, by using soft or harder wood, such as pine, oak, &c.

There are many other plants besides the *mouse-ear*, which will answer equally well; as its only use is to show that all the moisture has evaporated from the mixture.

Where it is wished to remove the blue colour from a sword, or any other article, a very weak solution of sulphuric acid, (oil of vitriol) or even good vinegar will answer the purpose.

Workmen are sometimes fearful of heating their steel to blue it a second time, apprehending that by so doing they may injure the instrument; but of this there is no danger; the blue colour may be taken off and restored any number of times, without producing this effect. When an article is tempered by bringing it to a particular colour, and it is found to be too hard, it will not be in the slightest degree reduced by brightening and bringing it again to the same colour, however frequently it may be repeated; it must in all cases be brought to a shade which indicates a lower temper.

On Improving the quality of Saws, by hammer-hardening their Teeth.

The Editor lately mentioning to Mr. Christie, the worthy Secretary of the London Mechanics' Institution, Mr. Turrel's great improvement in gravers, effected by hammer-hardening them, it occurred to him, that the practice, frequently adopted by smiths, and other workmen, of hammering the worn and blunted tops of the teeth of their back and frame-saws, merely with a view of spreading them sideways, so as to free themselves in use, previous to filing them sharp again, must not only have that effect, but must likewise greatly conduce to the improvement of their *hardness* and *toughness*, from the *condensing effect* of the hammer upon them.

Mr. J. I. Hawkins, on being informed of this, by the Editor, perfectly agreed in this opinion of Mr. Christie's; but, with his usual acuteness, suggested the farther improvement of first filing the teeth into shape, and then finishing them *by hammer-hardening their tops;* which would not only spread them out sideways, but would also preserve to them all the advantages of the effect of the hammer upon them; which, according to the present practice of filing them after hammering them, are in a great measure lost; and he thought there would be little difficulty in applying his improvement to the teeth of all saws, which were not exceedingly small. He would screw the saw fast in a vice, (the teeth in the chaps of which were guarded from indenting the saw, by plates of copper lining the chaps on each side) and, with the flat cross-pane of a hammer, the handle of which was held towards the fore part of the saw, and the hammer itself at a proper angle to suit the form of the teeth, he would then hammer-harden every individual tooth.*

The best saws are those which have been considerably condensed by hammer-hardening them on their sides, in making them; but this additional process, of hammering the tops of their teeth, cannot but prove a considerable improvement upon them.

[*Technical Repository.*

On the great improvement made in Bricklayer's Trowels, by hammer-hardening them. By Mr. George Walby.

There is, perhaps, no implement which undergoes more severe treatment than the bricklayer's trowel does, in its constant employment of hacking bricks into shape, and thus encountering the pieces of flint, pebbles, &c. ordinarily mixed with the clay; and which, besides having a tendency to injure its edges, also render it liable to break continually. Mr. Walby, therefore, by his excellent processes, accomplished a most difficult task, and rendered his superior trowels highly prized, by those persons who were the most competent judges of their merit, from their constant experience in their use; and, indeed, his brick-trowels, like the hand-saws made by the Editor's late father, were continually changed by grinding, into other and smaller kinds, until they became too diminutive for any useful purpose; their originally excellent quality remaining perfect to the last.

They were made of the best shear-steel, carefully worked throughout, and especially avoiding to over-heat the steel; and towards their finishing in the plating or forging, and when nearly reduced to their proper thickness, besides heating them in a clean hollow-fire, to avoid contact with cinders, &c. he also removed all scales upon their surface, by means of a very ingenious revolving elastic steel brush of his invention, previous to giving them their last planishing, under the rapid blows of a hammer driven by a steam-engine. He carefully attended to the proper hardening heat, and

* A punch would answer the purpose better.—Editor.

quenched them in a composition or hardening liquor, similar to those used by saw-makers; he next blazed them off to the spring temper; and, lastly, *hammer-hardened them as much as possible.* They were then ready for grinding, after which operation, their elasticity being again restored, by blueing them, they were glazed or brightened, ready to be mounted into their handles.

We have many particulars of the various tools used by Mr. Walby in his practice of trowel making, and which are well deserving of being published.

On the improvement of Drills, by hammer-hardening them cold.

Mr. Andrew Pritchard, the inventor of the hard shel-lac cement, finding that steel, when hardened and tempered, is susceptible of receiving the condensing effect of the hammer, has applied it with considerable advantage, to the points of small drills, by hammering them upon their flat surfaces.

On the employment of Cast-Steel Plates, for Engravers, in their Carbonated state.

We are glad to find that cast-steel plates are now beginning to be employed by some of our first rate artists, without having undergone the process of *decarbonating* them as usual. Their advantages are eminent, not only in the greater facility of etching cast-steel than iron, but chiefly in the increased number of impressions they will afford.

Here Mr. Turrell's improvement on the graver is invaluable; and indeed, previous to his informing his brother artists of his method of condensing their edges, by hammer-hardening them, the difficulties they had to encounter were nearly insurmountable.—[*ib.*

On Improving the edges of Penknives, by Burnishing them.

The Editor, following his old habit, of reasoning from analogy, thought, that as the advantages of burnishing the edges of currier's shaving-knives, cabinet-maker's steel-scrapers, and the turning tools for brass, were so manifest, in giving additional strength, toughness, and smoothness to their edges; so the application of it to the edge of a penknife, might likewise prove advantageous; and accordingly, having first carefully whetted the blade of his penknife, (which is one of the ordinary quality,) upon a Water of Ayr stone, with water, he finished it by a gentle and delicate stroke of the cylindrical part of the currier's burnisher, carried along its edge, so as to throw it forward a little from the back, or convex side of it, towards the concave side; and which he found to have effected a great improvement indeed, in its cutting qualities; it now seizing the quill, as it were, in making or mending a pen, and making a smooth polished cut, such as he was never able to effect by it previous to this application of the burnisher; and the edge has endured in use for a considerable time, in mending a number of the portable pens, laid out for that purpose; so that he can safe-

ly recommend it as a considerable improvement, on the edge of that useful and necessary instrument, the pen-knife.—[*ib.*

CAOUTCHOUC TUBES.

In page 61 of this Journal, we have given Mr. Leeson's method of making tubes of Indian rubber; in this paper a reference is made to his mode of distending the gum-elastic bottles, for constructing his *self-acting blow-pipe,* which will be found in the next article.

The forming of such tubes, by cutting the material into strips, and causing them to adhere by the aid of heat and pressure, has been long known, although it has been but little practiced; owing probably to the difficulty of cutting the strips with neatness and uniformity; a difficulty which is obviated by Mr. Leeson's method of distension.

Where tubes of considerable length are wanted, the method of making them, described by Mr. Thomas Skidmore in the 5th volume of Silliman's Journal, is undoubtedly to be preferred; as a long tube in contact with a rod of metal, or if glass, would adhere so firmly, as to render its removal impossible. Mr. Skidmore takes a cylindrical rod of iron of the desired length, round this he closely coils annealed wire, in the manner of a spiral spring; care being taken that the edges of the coiled wire shall touch each other, but shall at the same time not be so firmly wound, as to prevent its being slipped off the rod. The spiral wire is then covered with tape, coiled from end to end, and upon it are laid the strips of Indian rubber, wound in a similar manner, with their fresh cut and clean edges lapping upon each other; these are to be very firmly pressed together by another coil of linen tape; the rod is then withdrawn, the tube is boiled in water for an hour or two; and when cooled, the wire and tapes are to be removed. If the process has been properly managed, the tube, although rough, will be perfectly sound in every part.

When the purpose to which the tube is to be applied renders it desirable that it should not collapse, the inner tape may be omitted, and the caoutchouc wound immediately upon the wire, which in this case need not be annealed. For most purposes brass would be preferred to iron, as being less liable to corrosion from moisture.

When cut thin, or when extended, this subtance forms excellent washers, or collars for stop cocks; a very little pressure being sufficient to render them perfectly tight. Leather has also been coated with caoutchouc, and without being adhesive, is perfectly water tight, and free from odour.

SELF-ACTING BLOW-PIPE.

It is pretty generally known, that bottles of Indian rubber may be expanded to a considerable size, by condensing air into them;

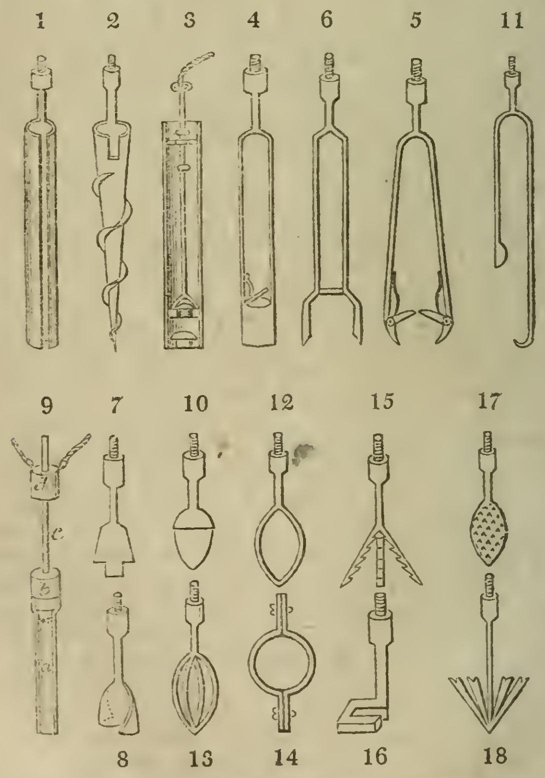
but Mr. H. B. Leeson is the first who has applied bottles so filled to the purposes of a blow-pipe. The bottles he makes use of, vary in weight from a half to three-quarters of a pound, and may be readily procured at any stationer's.

"To prepare them they should be boiled in water till completely softened; which, if they are put into water already boiling, will generally be accomplished in ten minutes or a quarter of an hour. They must then be taken out and suffered to cool, when a brass tube may be fitted into the neck of the bottle; having a small cork screwed into it at one end, by which it may be connected with the condensing syringe, and to which the blow-pipe jets may be attached. There should be a milled projection on the side of the tube for the purpose of more firmly attaching the bottle to it, which may be effected by passing a ligature of waxed string round the neck of the bottle on each side of the above mentioned projection. The bottle must next be filled with condensed air. After a few strokes of the syringe, a blister will be observed to form, which will gradually enlarge till the greatest part of the bottle (which must be selected uniform in substance and free from defects) has extended to a similar substance. The condensation should not then be continued farther. Bottles of the size I have mentioned, will generally extend from 14 to 17 inches in diameter without bursting, and I have occasionally extended them much beyond these dimensions; but in this the operator must, of course, be entirely directed by his own observations. The Indian rubber varies in its quality: there is one sort which appears of a blacker hue before extension, but becomes very thin and almost transparent on condensing air into it; whilst there is another sort having a browner colour, which is much less yielding in its substance, and cannot be extended to the same thinness as the former. I have found both sorts to answer my purpose; but the above observations may be useful in determining the quantity of air which may be condensed into the bottles with safety. To apply these bottles when filled with condensed air, nothing more is necessary than to remove the syringe, and in its place to screw on a jet of such bore as may be required. On opening the cock, the air will be expelled by the elasticity of the Indian rubber, and its own condensation, in a strong and uniform stream, which, in bottles of the size I have mentioned, will continue from 25 minutes to an hour, according to the size of the jet. When once prepared, the bottles may be constantly expanded to the same size, without any danger of bursting. When the air is exhausted, the bottles will be found somewhat larger in dimensions, but may again be contracted by holding them before a fire, or a few minutes' immersion in boiling water. This, however, is unnecessary, since no subsequent inflation will be found to increase the size of the bottle any further; and I have used the same repeatedly, without any apparent diminution of its elastic powers. The principle advantages of this blow-pipe are its great portability, and length and steadiness of action, (in which I consider it much superior to the hydraulic blow-pipe) together with the

perfect liberty at which, when properly mounted, it leaves the operator's hands. This blow-pipe is applicable to any of the gases, and may, I conceive, be applied with advantage to contain the explosive mixture of oxygen and hydrogen, as no inconvenience can possibly accrue from its bursting, beyond the loss of the bottle. This blow-pipe may be supplied with air or gas during an experiment, by having a separate communication for the syringe into the piece of tube before mentioned, and this will enable the operator to continue his experiments for any period of time.—[*Quarterly Journal of Science.*

ENGLISH PATENTS.

To JOHN GOOD, *of Tottenham, in the County of Middlesex, Engineer, for his invention of certain improvements in Machinery, tools, or apparatus for boring the earth, for the purpose of obtaining and raising water.*



In our last number, page 24, we gave a particular account of the novel and important practice of boring the earth for water, by

which means springs are discovered, and water raised from a considerable depth, at a very trifling expense compared to the ordinary process of well-digging.

The present patentee has been extensively employed in this business of boring the earth for water; and the implements which form the subject of this patent are such, as in addition to those we have before described, are found to be necessary or useful under different circumstances in the progress of that business; our readers will therefore perceive the advantage of these improved implements in a more forcible way, by first running over the previous account (which we have given with considerable exactness,) of the whole of the process of boring, and the tools then employed.

The cut, exhibits the newly invented implements; fig. 1 is an auger, to be connected by the screw-head to the length of rods by which the boring is carried on. This auger is for boring in soft clay or sand; it is cylindrical, and has a slit or opening from end to end, and a bit or cutting-piece at bottom. When the earth is loose or wet, an auger of the same form is to be employed, but with the slit or opening reduced in width, or even without a slit or opening. A similar auger is used for cutting through chalk, but the point or bit at bottom should then project lower, and for that purpose some of these cylindrical augers are made with moveable bits, to be attached by screws, which is extremely desirable in grinding them to cutting edges. Fig. 2 is a hollow conical auger for boring loose sandy soils; it has a spiral cutting edge coiled round it, which, as it turns, causes the loose soil to ascend up the inclined plane and deposit itself in the hollow within. Fig. 3 is a hollow cylinder or tube, shown in section, with a foot valve, and a bucket to be raised by a rod and cord attached at top; this is a pumping tool for the purpose of getting up water and sand that would not rise by the auger. When this cylinder is lowered to the bottom of the bore, the bucket is lifted up by the rod and cord, and descends again by its own gravity, having a valve in the bucket opening upwards like other lift pumps, which at every stroke raises a quantity of water and sand in the cylinder equal to the stroke, the ascent and descent of the bucket being limited by a guide-piece at the top of the cylinder, and two small nobs upon the rod, which stop against the cross-guide. Fig. 4, is a tool for getting up broken rods, it consists of a small cylindrical piece at bottom, which the broken rod slips through when it is lower, and a small catch with a knife-edge, acted upon by a back-spring. In rising, the tool takes hold of the broken rod, and thereby enables the workmen at top to draw it up. Another tool for the same purpose is shown at fig. 5, which is like a pair of tongs; it is intended to be slidden down the bore, and for the broken rod to pass between the two catches, which pressed by back springs, will, when drawn up, take fast hold of the broken rod.

Fig. 6 is a tool for widening the hole, to be connected, like all the others, to the end of the length of rods passed down the bore; this tool has two cutting-pieces extending on the sides at bottom,

by which, as the tool is turned round in the bore, the earth is peeled away. Fig. 7 is a chisel, or punch, with a projecting piece to be used for penetrating through stone; this chisel is by rising and falling made to peck the stone and pulverize it; the small middle part breaking it away first, and afterwards the broad part coming into action. Fig. 8 is another chisel, or punching tool, twisted on its cutting edge, which breaks away a greater portion of the stone as it beats against it.

The manner of forcing down lengths of cast iron pipe, after the bore is formed, is shown at fig. 9; *a* is the pipe in the socket, at the end of which a block *b*, is inserted, and from this block a rod *c*, extends upwards, upon which a weight *d*, slides. To the weight *d*, cords are attached, reaching to the top of the bore, where the workmen alternately raises the weight and lets it fall, which by striking upon the block *b*, beats down the pipe by a succession of strokes; and when one length of pipe has by these means been forced down, another length is introduced into the socket of the former. Another tool for the same purpose is shown at fig. 10, which is formed like an acorn, the raised part of the acorn strikes against the edge of the pipe, and by that means it is forced down the bore. When it happens that an auger breaks in the hole, a tool similar to that shown at fig. 11 is introduced; on one side of this tool a curved piece is attached, for the purpose of a guide to conduct it past the cylindrical auger, and at the end of the other side is a hook, which taking hold of the bottom edge of the auger, enables it to be drawn up.

Wrought iron, copper, tin, and lead pipes, are occasionally used for lining the bore; and as these are subject to bends and bruises, it is necessary to introduce tools for the purpose of straightening their sides. One of these tools is shown at fig. 12, which is a bow, and is to be passed down the inside of the pipe, in order to press out any dents. Another tool for the same purpose is shown at fig. 13, which is a double bow, and may be turned round in the pipe for the purpose of straightening it all the way down. Fig. 14 is a pair of clams, for turning the pipe round in the hole while driving.

When loose stones lay at the bottom of the hole, which are too large to be brought up by the cylindrical auger, and cannot be conveniently broken, then it is proposed to introduce a triangular claw, as fig. 15, the internal notches of which take hold of the stone, and as the tool rises brings it up. For raising broken rods a tool like fig. 16 is sometimes employed, which has an angular claw that slips under the shoulder of the rod, and holds it fast while drawing up.

In raising pipes, it is necessary to introduce a tool to the inside of the pipe, by which it will be held fast. Fig. 17 is a pine-apple tool for this purpose, its surface is cut like a rasp, which passes easily down into the pipe, but catches as it is drawn up, and by that means brings the pipe with it. Fig. 18 is a spear for the same purpose, which easily enters the pipe by springing, at the ends of

its prongs there are forks which stick into the metal as it is drawn up, and thereby raise it.

These are the new implements for which the patent is granted; in the process of boring there does not appear to be any thing new proposed, but that these several tools are to be employed for boring, pecking, and otherwise penetrating, raising the earth, and extracting broken or injured tools. There are also suggestions for employing long buckets with valves opening upward in their bottoms, for the purpose of drawing water from these wells, when the water will not flow over the surface; also lift pumps, with a succession of buckets for the same purpose; but as these suggestions possess little, if any novelty, it cannot be intended to claim them as parts of the patent.

To John Christie, *of Mark Lane, in the City of London, Merchant, and* Thomas Harper, *of Tamworth, in the County of Stafford, Merchant, for their Invention of an improved method of combining and applying certain kinds of Fuel.*

This invention is the combination of bituminous coal, with stone-coal, culm, and anthracite, in such proportions as will burn in furnaces and kilns without emitting smoke. The proportions of the materials combined must necessarily depend upon their qualities, and the draft of the fire-place. The quantities of each may be considered generally as varying from one-fifth to one-third bituminous coal, and the remainder stone-coal, culm, or anthracite; the intention of the patentees being to use only so much bituminous coal in the mixture, as may be found necessary to keep up a fire suitable for the various processes to which it may be applied in our manufactories, without giving out smoke.

The inferior kinds of coal, such as stone-coal, culm, and anthracite, when in a state of combustion, give out little or no flame or smoke, though they become heated to redness; it is therefore only necessary to add so much bituminous coal as will stimulate or invigorate the other coal and keep it burning. The patentees have found upon trial, that one quarter of bituminous coal is a good proportion, when the bars of the furnace are one inch wide, and half an inch asunder, there being a good draft. Stone-coal may be employed, or mixed with culm, in the proportions of one half of each, and this mixed as above, and applied to furnaces, will burn without emitting smoke; it is particularly applicable to hot air stoves, and to mix with cinders or brees for the burning of bricks.

Note.—The object which the foregoing patent proposes to attain, is one of very great interest, not only to Pennsylvania, but also to various other parts of the United States where anthracite abounds, or to which it can be readily transported. Several of the premiums offered this year by the Franklin Institute, relate to the employment of this fuel for various purposes, either alone, or mix-

ed with bituminous coal. It is to be regretted, that hitherto, so few experiments have been instituted to test its applicability to various purposes in the arts; the difficulties which were encountered in employing it in domestic economy, were, but seven years ago, by many persons deemed insurmountable; yet it is now managed not only with facility, but with much less trouble than our ordinary wood fires; and but few persons who use it, would be willing to substitute for it, bituminous coal. In England the want of a sufficient quantity of wood to convert into charcoal, was once thought to be an insurmountable obstacle to the extension of the manufacture of iron; and if those who were interested, had rested upon the declaration, that it was impossible to use pit coal for the purpose, what would now have been her resources, her power, or her wealth?

To Joseph Barlow, *of the New Road, in the Parish of St. George, in the East, in the County of Middlesex, Sugar Refiner, for his new invented method or process for bleaching and clarifying, and improving the quality and colour of sugars, known by the name of bastards and piece sugars.*

The sirop extracted from the cane in the West Indies, is boiled to a consistency, which produces that crystallized article called Muscovado sugar, (the superior quality of moist sugar,) the runnings from which, is the West Indian molasses sent to Europe in puncheons. This molasses, when boiled here, produces the brown sugar, called in the trade, bastards.

The ordinary mode of making bastard sugar from the West Indian molasses, is by boiling the molasses in pans or coppers, until the aqueous parts are in a great measure evaporated; then removing the liquor from the pan by means of ladles, and pouring it into earthen moulds of a conical figure, where the remaining molasses descends to the bottom of the vessel, and leaves the sugar above in a crystallized state. After a day or two, the lower end or apex of each conical mould is opened, and the molasses allowed to run out into a pot, leaving only the crystals of sugar in the mould, which in that state is called bastard sugar.

In order to clarify and bleach this sugar, the tops of the moulds are coated, a few inches thick, with a solution of clay in water, stirred up to a stiff consistency; and as the water descends from the clay through the sugar, (which usually takes about a week,) the colouring matter is absorbed by it, and passes off in the state of a thick brown sirop, or molasses, at bottom; leaving the sugar above, considerably whitened; but in this process, a portion of the sugar itself is dissolved and taken up by the water, and consequently the quantity remaining in the mould becomes reduced; and the sirop or molasses, which thus runs from the moulds, being sold at a small price, causes a very considerable loss to the maker.

To obviate this objection to the ordinary process, and save that portion of sugar which usually descends into the molasses, or sirop,

the present invention is proposed; which consists in employing a quantity of molasses in the state in which that article is received from the West Indies, as a bleaching material, instead of the clay and water.

The bastard sugar being in a crystallized state in the mould, as above described, with the colouring matter in it, it is proposed to pour upon the top of the sugar in the mould, a quantity of the West Indian molasses; which, after a few hours, will have passed through the mass, and have carried the colouring matter with it, without reducing the quantity of sugar that had been previously crystallized in the mould. If the molasses should happen to be too thick for the purpose, it may be reduced by the addition of a quantity of water; experience alone, can determine the suitable thickness.

There are three modes of producing bastard sugar; (viz.) boiling the West Indian molasses by itself, boiling the sirop which runs from the process of refining or making lump sugar, and boiling the said sirop and West Indian molasses together. It sometimes happens that broken lumps, which is called piece sugar, is mixed with the molasses to assist the crystallization; whatever, therefore, be the mode by which the sugar is produced, the improved mode of clarifying and bleaching appears; the claim of the patentee being the employment of molasses for extracting the colouring matter from sugars, in the manner above described.

To Francis Henry William Needham, *of Davis Street, Fitzroy Square, in the County of Middlesex, Esq. for his Invention of an improved method of casting steel.*

These improvements in casting steel, consist in melting the steel in large quantities in capacious pots, crucibles, or other suitable vessels, which are to be fixed in furnaces; and when so melted, the steel is to be run from the fixed crucibles, through lateral tubes to the mould, instead of withdrawing the melting pot from the furnace and pouring off the metal, as in the ordinary mode of casting.

In the furnace (which may be constructed according to any of the usual plans) it is proposed to fix the crucibles or melting pots upon fire-brick or stone bearers, so as to allow the fire to envelop them in a similar way to the retorts for generating gas. The crucibles or melting pots are to be made of fire-stone, Stourbridge clay, or any other material that will sustain the action of the fire; they are formed something in the shape of troughs or deep dishes with moveable covers, and are placed upon the bearers, inclining a little from the horizontal. At the lower part of the crucible, an aperture is made, from which a tube extends to the outside of the furnace; and when the steel is perfectly fused, a plug or stopper is to be withdrawn from the outer extremity of the tube, and the fluid metal allowed to run off, which the inclined position of the crucible will facilitate.

In this way, a single crucible or melting trough, or two or more crucibles or melting troughs, may be fixed in one furnace, the fire being made to act upon them all at the same time; by which means a larger quantity of steel may be fused for casting, than in the moveable crucibles, and consequently articles of greater magnitude and substance may be cast in steel by these means, than by the modes heretofore adopted.

As steel of different qualities, requires different degrees of heat to bring it into fusion, it will be necessary to place that steel which is least fusible, in the crucible most powerfully acted upon by the fire; and the more easily fusible, in the upper crucibles; by which means the patentee considers that he shall be enabled, in casting large and heavy articles, such as shafts or cylinders, to employ steel of the best quality, in casting such parts of the article as require it, and an inferior kind of steel, in the other parts; consequently, he expects to produce such articles at a less expense. For instance, in casting a large cylindrical roller of steel, the interior of which might be of an inferior quality of steel, he places a cylinder of wrought iron within the mould as a partition, and causes jets of fluid steel of dissimilar qualities, to flow at the same time from two of the crucibles, into the mould; by which means the fluid steel would adhere to the wrought iron cylinder, and thereby form a solid roller. In casting articles of smaller dimensions in steel, such as horse shoes, hammers, axletrees, and other things which have usually been forged, it is proposed to employ portable iron moulds, which when properly braced together, are to be brought under the jet of fluid steal, and held in such positions that the metal may flow into the bottom of the mould, and thereby drive the air upwards, which must be allowed to escape through small apertures.

The specification concludes by saying, the claim of invention consists in "employing fixed crucibles or melting pots for the fusion of steel, which are to be seated in a furnace, and in causing the fluid steel to flow through pipes or tubes, from the crucible to the moulds. In adapting this invention, I do not mean to confine myself to the form or dimensions of the melting pots, but to employ such forms and dimensions as circumstances may render eligible; neither do I confine my invention to any particular form or construction of furnace, but mean to employ such furnaces as may be found best suited to the adaptation of my invention."

To Louis Lambert, *of Rue de la Gout, in the City of Paris, in the Kingdom of France, but now residing in Cannon-street, in the City of London, Gentleman, for his Invention of certain Improvements in the Materials and Manufacture of Paper.*

These improvements consist in reducing straw into pulp suitable for making paper, and in extracting the colouring or other matter therefrom. The method is this; first, to procure a quantity of straw and cut away all the knots, (any particular kind of straw is not

mentioned,) the straw is then boiled with quick lime in water, for the purpose of extracting the colouring matter, and separating its fibres. Caustic potash, soda, or ammonia may be employed for this purpose, instead of lime. When this is done, it is to be washed in clean water, in order to remove the colour that has been extracted, and also the slaked lime. The fibrous substance is then submitted to the action of a hydro-sulphuret, composed of quick lime and sulphur in solution, in the proportion of four ounces of quick lime to one of sulphur, with one quart of water, in order to get rid of the mucilaginous and silicious matters. After this the fibrous material must be thoroughly washed in successive waters, until all the alkaline matters are removed, and there is no smell of the sulphur left; this may be done by beating in a paper mill, or by any other economical means: it is then pressed to extract the water from the fibres, and bleached in the ordinary way, either with chlorine, or with lime, or by exposure to the light and air, upon a grass plat.

The bleaching process having been completed, the material is again washed until all chymical matters are entirely removed from it, when it is considered fit to be introduced to the ordinary rag engine, employed in making paper, for the purpose of reducing it to pulp, previously to moulding it into sheets.

Dressing Hats by Machinery.

A Patent has been granted to Edward Ollerenshaw, of Manchester, Hat Manufacturer, for a method of dressing and finishing hats, by means of machinery. To effect this, the hat is fixed upon a block in the usual manner; the centre piece of the block is furnished with a screw, by which it may be attached to a lathe, it is then made to revolve with a slow continuous motion, making about twenty turns in a minute; the workman holds in his left hand, a small cushion covered with plush, which he applies to the hat on the far side, whilst the hot iron is passed in succession over every part of the crown. When this is finished the hat is fixed upon a horizontal lathe, where the tip or flat top of the hat is dressed in the way before described; it is then removed to a third spindle, running horizontally, and furnished with a suitable support for the brim, the top surface of which is then finished. To complete the operation, the hat is removed to another horizontal lathe, prepared to receive the crown, so that the lower part of the brim may be turned upwards, it being at the same time properly supported by a rim of wood in a suitable shape. It is now made to revolve with about half the former velocity; which, whilst it presents every part in succession to the workman, admits of his drawing the heated iron, from the inner, towards the outer edge of the brim. Each of these operations is repeated a second time, when the dressing is completed.

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. II.

On Mechanics' Liens.

The Legislature of Pennsylvania have passed several acts, with the declared intention of securing to Mechanics, and others, payment for their labour and materials in erecting any building.

The first of these laws is dated April 1, 1803. It was probably meant as an *experiment*, for it was limited to three years; and being, in some respects, defective, was repealed in 1806, shortly before the time that it would have expired by its own limitation.

The second and principal law now in force, was passed on the 17th of March, 1806, and is without limitation.

To this Act a Supplement was made on the 28th day of March, 1808.

The two first of these laws were originally confined to a very narrow district, but by the third and various other statutory provisions, their benefits have been extended to many other parts of the state. Upon these laws, various decisions of our courts have taken place, which will be noticed in their order. There is scarcely a reader of this Journal, to whom a general knowledge of the law of liens is entirely unimportant. To all the various mechanics and material men, who are concerned in the erection of a building, the proper understanding of laws designed for their peculiar benefit, is an advantage so obvious, that it need not be insisted upon; and a few moments reflection will convince us that many others have an interest in this subject. The mechanics' lien, if effectual, operates not only on the *house*, but upon the *ground*, whereon it is erected; and hence it is that its provisions are important to all who are landholders. When properly attached, it is preferred before all *other liens*, which originate subsequently to the commencement of the building; every person, therefore, who takes the common securities of a mortgage, or judgment bond, or who recovers a judgment in one of our courts, will be unable to understand the extent of his security, if he is entirely ignorant of this system. I therefore, was not at all surprised at the desire which was expressed by a number of the members of the Institute, to publish these essays. If I shall be able to comply with the request to the satisfaction of my readers, I shall be much gratified.

A proper consideration of these Laws will involve the following questions.

1. What is necessary to a create a lien.
2. Upon what the lien shall attach.
3. The nature of the preference given.
4. The time the lien may exist.
5. The manner of entering a lien, or instituting a suit.
6. The proceedings to recover the amount of a lien.
7. The consequence of a deficiency of assets to pay all the lien creditors.

8. The duty of the lien creditor upon the receipt of his debt; and the consequence of not performing it.

1. What is necessary to create a lien.

There must be a contract. This will lead me to enquire,

As to the *parties* to the contract.

The *subject matter* of the contract.

The *time* within which the contract is executed.

The *place* over which the contract operates.

That there must be a contract, appears to be clear from the wording of the law of 1803 and 1806; and the lien must arise out of such *contract*, express or implied. The words are "all and every dwelling house and other building, &c. shall be subject to the payment of the *debts contracted* for, or by reason of any work done or materials found," &c.

If, therefore, we could suppose any one to be so foolish as to labour or furnish materials in erecting a building without *any contract whatever*, such a man, I apprehend, would have no lien. I wish, however, to be understood to speak of a case of *no contract whatsoever, express*, or *implied*. We must distinguish between *the contract*, and *the evidence* of the contract. This contract like all others, may be established by *positive* or *presumptive testimony*.

Parties to the Contract.

The Mechanics or Material Men.—The act of 1806, like the previous one of 1803, enumerates eleven descriptions of persons, as lien creditors, viz:—the brick-maker, brick-layer, stone-cutter, mason, lime-merchant, carpenter, painter and glazier, ironmonger, blacksmith, plaisterer, and lumber merchant.

There are, however, it is well known, many other persons, who contribute their labour or materials, in the erection and construction of a building; as for instance, the cellar, foundation, and well digger, the curb-stone merchant, the paver, the tile-merchant, the slate merchant, the tiler, the slater, the plumber, the copper-smith, the tin-plate worker, the turner, the paper stainer, the paper-hanger, the bell-hanger, the wall-stainer, and perhaps others. It becomes an important question, therefore, whether these, or any of them are included in the statutes.

What was the intention of the legislature? for that ought to be the *polar star*, to guide us in the construction of statutes. Did they mean, by enumerating the eleven persons above named, to exclude *all* others, according to the maxim "*expressio unius est exclusio alterius?* or were *they* put merely by way of *example?* If we were to weigh the mere *probabilities* of the case, the argument would, it appears to me, preponderate in favour of some of the persons not enumerated. If they contribute their labour, or their materials, they are equally meritorious with those specified; and it is alike inconsistent with the principles of equity, and the equality of rights, which are the basis of our government, to grant greater securities to one class of citizens, than to another. But we are not

obliged to resort to *probabilities*, for we have the express declaration of the legislature, that the preference shall be given, not only to the mechanics and material men enumerated, but "to any other person or persons employed in furnishing materials for, or in the erecting and constructing such house or other building."

These expressions plainly bespeak the opinion of the legislature, that *all* the persons who were to be aided by the act, were *not specially* mentioned; but that others were meant to be included in this general clause; and our courts confirmed this construction of the act, the moment they admitted *any one person* to participate, who was not among those enumerated.

It remains then to enquire into the extent and limit of this admission. The word "*other*," has, in statutes, as in common parlance, an extensive signification. The st. 13 Eliz. c. 5. enacts that all feoffments, gifts, grants, &c. to delay, hinder, or defraud creditors and *others* of their just and lawful actions, &c. shall be void. And it has been decided, that this statute doth extend not only to creditors, but to *all others*, who had cause of action or suit, or any penalty, or forfeiture, &c. 3 *Co.* 82. But the clause in the act of 1806, not only speaks of "*another*," but "*any other*," thereby giving the greatest possible latitude of admission. Justice and reason seem therefore to coincide in favour of admitting *any person* employed, as the act describes, in furnishing materials for, or in the erecting or constructing of a building.

I have been informed that very soon after this act was passed, it was decided that the person employed to dig the cellar of a house, was adjudged to have a lien. I will not vouch for the accuracy of the information, but this I am enabled to say, that the general understanding at the bar, as far as I have been able to collect it, is, that the persons who dig cellars, are entitled to a lien, and the uniform practice has been to admit them, without opposition; which furnishes strong evidence that such has been the decision.

The act creates a lien in favour of those who furnish materials or perform labour in paving with stone between the foot pavements of a court, laid out for the convenience of buildings erected fronting on the same.

This point came before the district court for the city and county of Philadelphia, in January, 1815, in the case of M'Ilhenny and others, *vs.* Pratt and others.

In the case of Leiper, *vs.* Smith, the judges, (M'Kean and Barnes) decided that there was no lien for curb-stone.

By the second section of the act of the 24th of March, 1819, it was enacted "that the act of 1806 should be extended to any person or persons furnishing curb-stone for the pavement of any house or building, erected within the meaning of the act, and that the person so furnishing curb-stone, as aforesaid, should enjoy all the benefits and advantages of the said act and the supplement thereto, as fully and effectually as if they had been therein particularly mentioned."

This legislative provision in favour of persons furnishing curb-stones, is not *conclusive* evidence that they were not concluded in the former act. A great luminary of the law informs us, that one function of the legislative branch of the government is, *to correct the mistakes and unadvised determinations of unlearned* (or even learned) *Judges.*—I. Black. Com. 86.

Justice to the bench requires that we should likewise say, that it furnishes no conclusive evidence that the court were wrong; for the omission *may* have been in the law of 1806. The question is open.

The paper-stainer and paper-hanger have no lien on the building.

This was decided in the district court for the city and county of Philadelphia, judges Ingersoll, M'Kean and Morgan, in the case of Hurley, *vs.* Lybrand, after argument by Mr. Kittera for Hurley, and Mr. H. Hopkins for Lybrand.

The plumber has no lien on the building.

This was decided by the district court for the city and county of Philadelphia, judges Ingersoll, M'Kean and Morgan, in the case of Rowley & Alberger, *vs.* Lybrand, after argument by Mr. Potts for Rowley & Alberger, and Mr. H. Hopkins for Lybrand.

And although *journeymen* would be included within the *literal* meaning of the terms "any other person or persons employed in furnishing materials for, or in erecting and constructing such house or other building," yet they have no lien.

This point, concerning the journeymen, was decided in Cobb, *vs.* Traquair. The suit was brought in the district court for the city and county of Philadelphia, in December term, 1819, No. 859. It was tried on the 27th of March, 1820, Mr. Kittera for the plaintiff, and Mr. Swift for the defendant, and a verdict was given for the defendant. On the 30th of March, 1820, Mr. Kittera moved for a new trial, and filed the following reason.

"The court erred in charging the jury that the plaintiff had no claim for work done to the defendant's building, because he was not the original contractor, but worked under Richard Ware, who made the contract with the defendant." The rule was granted on the 29th of April, and on the first day of May, after argument before judges M'Kean and Barnes, the rule was discharged.

FOR THE FRANKLIN JOURNAL.

ON HARDENING STEEL DIES.

Mr. Editor,—I avail myself of the opportunity you offer, to record in your useful repository, the observations made by ingenious practical mechanics, in the prosecution of their respective arts. It will no doubt comport with your views, to give to merit its just due, by stating the origin of processes already known, as well as to make the knowledge of them, more extensive.

The management of steel for nice purposes in the arts, is of vast importance, and requires considerable practical skill; it has consequently been made the subject of numerous experiments, which within the course of a few years have resulted in the discovery of many improvements. The general method of hardening this metal, is to heat it red hot, and then to plunge it into cold water, and sometimes into mercury, in order to reduce its temperature as quickly as possible; to effect this cooling with the requisite rapidity, the article when plunged, is moved about, in order to expose it to new surfaces of the cold fluid. This method answers in general, with small or thin pieces of steel, but not when the mass is considerable; in this case, the article frequently breaks in the operation, or is hardened at the edges only; from this cause much inconvenience, and great loss, have frequently resulted to those interested in the hardening of steel dies, for striking medals, coins, &c. This has been frequently experienced in the mint of the United States; the dies after being completely finished, excepting the process of hardening, were very often destroyed in this attempt; or if they passed safely through this ordeal, were found to be incapable of sustaining the severe and repeated blows to which they, in their use, were subjected. An intimate friend of the writer, it is believed, was the first person who succeeded in obviating these difficulties so completely, that not the slightest danger is now apprehended from the process.

Mr. Adam Eckfeldt, the present chief coiner in the mint, a very ingenious practical mechanic, whose original profession was that of a smith, was employed in the infant state of the establishment, to manage this department. Aware that the cause of the frequent failures in the process alluded to, was the sudden contraction of the steel on the outside, whilst the inside was in a heated and expanded state, causing the outer hardened and brittle coat of steel to crack or burst, he adopted the following expedient. He caused a vessel holding 200 gallons of water, to be placed in the upper part of the building, at the height of 40 feet above the room in which the dies were hardened; from this vessel, the water was conducted down through a pipe of one inch and a quarter in diameter, with a cock at the bottom, and nozzles of different sizes, to regulate the diameter of the jet of water. Under one of these was placed the heated die, the water being directed on the centre of the upper surface. The first experiment was tried in the year 1795, and the same mode has been ever since pursued, without a single instance of failure.

By this process the die is hardened in such a way, as best to sustain the pressure to which it is to be subjected, and the middle of the face, which by the former process was apt to remain soft, now becomes the hardest part. The hardened part of the die so managed, were it to be separated, would be found to be in the form of a segment of a sphere, resting in the lower soft part, as in a dish; the hardness of course gradually decreasing as you descend to-

wards the foot. Dies thus hardened, preserve their forms until they are fairly worn out.

I am aware that the above mode is now in frequent use, as Mr. Eckfeldt never wished to keep it secret; a gentleman of the mint, communicated the process to a friend in Birmingham, England, where, it is believed, it was not previously known.

Should you think the above information worth publishing, you will probably receive some other communications, containing improvements effected by the same gentleman.

Yours very respectfully,

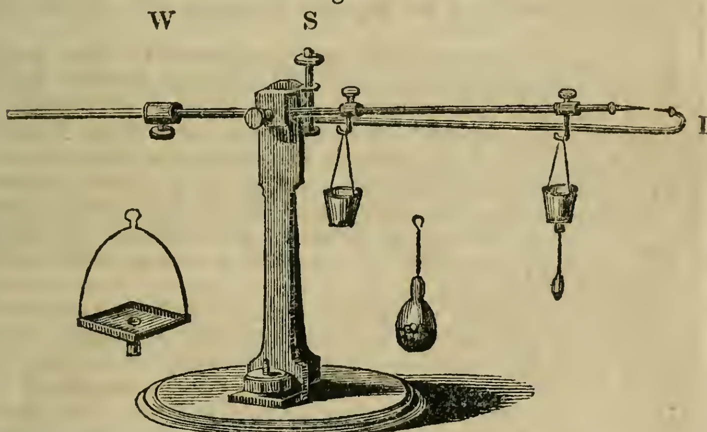
K.

ON SPECIFIC GRAVITY.—No. II.

By Robert Hare, M. D. *Professor of Chymistry in the University of Pennsylvania.*

To find the specific gravity of a Mineral, without calculation, and without degrees.

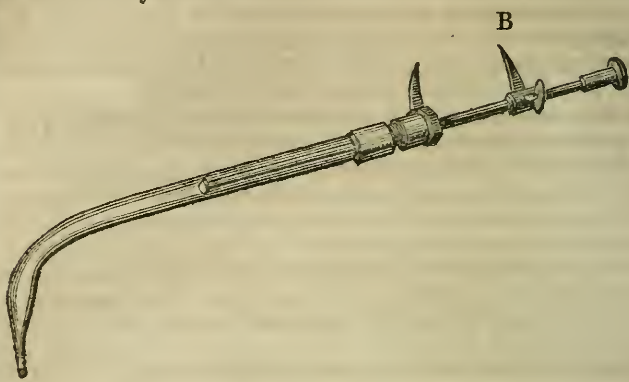
Fig. 5.



The preceding figure represents a balance employed in this process. It is, in two respects, more convenient than a common balance. The moveable weight on one of the arms, renders it easier to counterpoise bodies of various weights; and, the adjustment of the index (I) by the screw (S) to the beam, saves the necessity of adjusting the beam to the index; the accurate accomplishment of which, by varying the weights, is usually a chief part of the trouble of weighing.

One of the buckets, suspended from the beam, is five times as far from the fulcrum as the other.

A chyometer is employed in this process, of which the following figure will convey a correct idea.



The rod of this instrument is not graduated, but is provided with a band, (B) which can be slipped along the rod, and fastened at any part of it by means of a screw.

Let a mineral be suspended from the outer bucket, and rendered equiponderant with the counter-weight, (W) by moving this further from, or nearer to the fulcrum, so that the index point (I) may be exactly opposite the point of the beam. Place under the mineral a vessel of water, and add as much of this fluid to the bucket, by means of the chyometer, as will cause the immersion of the mineral. The band (B) which is made to slip upon the rod, should be so fastened, by means of the screw, as to mark the distance which the rod has entered, in expelling the water, requisite to sink the mineral. Having removed the vessel of water, and the mineral, ascertain how many times the same quantity of water, which caused the immersion of the mineral, must be employed to compensate its removal.

Adding to the number, thus found, one, for the water, (previously introduced into the bucket, in order to cause the immersion of the mineral) we have its specific gravity; so far as it may be expressed without fractions. When requisite, these may be discovered by means of the second bucket, which gives fifths for each measure of water; which, if added to the outer bucket, would be equivalent to a whole number. By the eye, the distance is easily so divided, as to give half fifths, or tenths. Or, the nearest bucket, being hung one half nearer the fulcrum, the same measures will become tenths in the latter, which would be units, if added to the outer bucket.

Rationale.

The portion of the rod, marked off by the band, was evidently found competent, by its introduction into the tube of the chyometer, to exclude from the orifice a weight of water, adequate to counteract the resistance encountered by the mineral in sinking in wa-

ter: consequently, agreeably to the general rule,* to find the specific gravity of the mineral, we have only to find how often this weight (of water) will go into the weight of the mineral—or, what is the same in effect, how often the former must be taken, in order to balance the latter. Indeed it must, otherwise, be sufficiently evident, that the mineral and the water being made equal in weight, their specific gravities must be inversely as their bulks, which are known by the premises.

The inner bucket may be dispensed with, and greater fractional accuracy attained, by means of a sector, graduated into 100 parts. It is for this purpose that the sliding band, and the ferrule at the but-end of the tube, are severally furnished with the points. The assistance of a sector is especially applicable, where fluids are in question, since it is necessary to find their differences in thousandth parts.

To find the specific gravity of a liquid, by the Sectoral Chyometer.

Let a glass bulb, (represented in figure 5, under the buckets,) be suspended from the outer bucket, and counterpoised. Let the situation of the beam be marked, by bringing the point of the index opposite to it. Let the tube of the chyometer be full of water, and the rod retracted, until stopped by an enlargement purposely made at its inner termination. Next return it into the tube, until as much water is projected into the bucket, as is just adequate to cause the immersion of the bulb. Let the band be fastened upon the rod, close to where it enters the tube, so as to mark the extent to which it may have entered. The rod must in the next place, be drawn out from its tube, to its first position; and the sector so opened, as that the points may extend from 100 degrees on one leg to 100 upon the other. Leaving the sector thus prepared, place under the suspended ball, a vessel containing an adequate quantity of the fluid, whose gravity is required. If the fluid be lighter than water, in order to cause the immersion of the bulb in it, the rod will not have to enter so far, as at first. This distance being marked, by fixing the sliding cylinder, and the rod withdrawn from the tube as far as allowed by the stop, the number on each leg of the sector, with which the points will coincide, gives the gravity of the fluid. Forcing as much water into the bucket as had been sufficient to sink the bulb in water, will not sink it in a heavier liquid; consequently, in the case of such liquids, it will be necessary to fill the chyometer a second time, and force as much more water from it, as may be sufficient to cause the immersion of the bulb. The sliding band being then fixed, and the points separated and applied to the sector, as before, the number to which they extend must be added to the weight of water = 100, for the specific gravity of the fluid in question.

Small differences are better found by subtraction; as, for instance, suppose the specific gravity of the fluid were 101; after the small

* See No. 1, page 44.

addition of water made to the bucket, beyond the 100 parts required for the immersion of the bulb *in water*, (the band being unmoved), the points would extend from 99 on one leg, to 99 on the other. The difference between this number, and 100, is then to be added to the weight of water; so that the specific gravity is found to be 101.

The angle made by the sectoral lines in using the same bulb, and the same rod, will always be the same. Hence, a stay may be employed to give the sector the requisite opening.

Indeed, were liquids alone in question, an immoveable sectoral scale would answer. Thus prepared, it were unnecessary to have recourse to water, excepting in the first adjustment of the scale. The number of parts required to merge the bulb in any fluid, will reach (at once or twice) the number, or numbers, on the sector, which give the required gravity.

In this process, if greater accuracy be desirable, it is only necessary to employ a smaller rod or a larger bulb. Instead of effecting an immersion by one stroke of the rod, it may be done by ten strokes, which will make each division of the sector indicate a thousandth of the bulk of the bulb.

The following process is, however, preferable, as the sector is made to give the answer in thousandths, without the delay of filling and emptying the chyometer more than once.

Let the distance on the rod of the chyometer be ascertained; which, when introduced five times successively, will exclude just water enough to overcome the resistance encountered by a globe, in sinking in that fluid. Let the sector be opened, to the distance so designated: let the globe be partially counterpoised, so as to float in any liquid heavier than 800. The apparatus being thus prepared, if the globe be placed in a liquid, in which it floats, add as much water, from the chyometer, to the scale, from which it hangs, as will sink it—and, by means of the points and the sector, ascertain the value of the distance to which the rod has been introduced. Adding the numbers, thus found, to 800, the sum will be the specific gravity of the liquid.

For this process, the sector should be divided into 200 parts, and, the proper opening being once duly ascertained, should be preserved by means of an arc, like that attached to common beam compasses.

Instead of a globe, a hydrometer, surmounted with a cup, may be employed, either with a graduated, or a sectoral, chyometer.

Before taking leave of the reader, it may be proper to explain the use of the square dish, which may be seen to the left, under the beam, (figure 5.) The arc of wire is for the purpose of suspending the dish to the hook, in place of the outer bucket. When so suspended, filled with water, and duly balanced, it will be found soon to become sensibly lighter, in consequence of the evaporation of the water. By means of the chyometer, it is easy to ascertain the different quantities evaporated, in similar times, at different periods, and in different places; so that, guarding against the effect

of aërial currents, hydrometrical observations may be made with great accuracy.

In lieu of having points attached to the chyometer, as represented in the figure, it may be as convenient to have two small holes, for the insertion of the points of a pair of compasses, either of the common kind, of the construction used by clock makers, or that which is known under the name of beam compasses.

The compasses may be used to regulate the opening of the sector, or to ascertain, by the aid of that instrument, the comparative value of the distances which the rod of the chyometer has to be introduced into its tube.

In order to convey an idea of the nature of the sector to any reader who may be unacquainted with it, I trust it will be sufficient to point out, that its construction is similar to that of the foot-rule used by carpenters. We have only to suppose such a rule, covered with brass, and each leg graduated into 200 equal parts, in order to have an adequate conception of the instrument employed by me.

A more particular explanation of the principle of the sector, may be found in any Encyclopedia, or Dictionary of Mathematics.

WATER WHEELS.

On the construction of water wheels and the method of applying the water for propelling them so as to produce the greatest effect.

To the Committee of the Franklin Institute in Philadelphia.

In constructing water-wheels, especially those of great power, the introduction of iron is a most essential improvement, and if this metal, and artisans skilled in the working it, could be obtained at reasonable rates, water wheels might be made wholly of it, and prove ultimately the cheapest, as if managed with due care, and worked with pure (not salt) water, they would last for centuries; but as the first cost would be an objection, I would recommend in all very large wheels that the axis be made of cast iron, and in order to obtain the greatest strength with the least weight, the axis or shaft ought to be cast hollow, and in the hexagon or octagon form, with a strong iron flange to fix each set of arms and the cog wheel upon; these flanges to be firmly fixed in their places with steel keys.

On the adaptation of water wheels to the different heights of the water falls by which they are to be worked, I remark that falls of 2 to 9 feet are most advantageously worked with the undershot wheel; falls of 10 feet and upwards by the bucket or breast wheel, which up to 20 or 25 feet ought to be made about one-sixth higher than the fall of water by which it has to be worked; and in wheels of both descriptions, the water ought to flow on the wheel from the

surface of the dam. I am aware that this principle is at direct variance with the established practice, and perhaps there are few wheels in these states that can be worked as they are now fixed, by thus applying the water; the reasons will be apparent from what follows.

In adjusting the proportions of the internal wheels by which machinery is propelled, it is necessary, in order to obtain the greatest power, to limit the speed of the skirt of the water wheel, so that it shall not be more than from 4 to 5 feet per second; it having been ascertained by accurate experiments, that the greatest force of water obtainable, is within these limits. As a falling body, water descends at the speed of nearly 16 feet in the first second, and it will appear evident that if a water wheel is required to be so driven, that the water with which it is loaded has to descend 10, 11, or 12 feet per second, at which rates wheels are generally constructed to work, that a very large proportion of the power is lost, or rather, is spent, in destroying, by unnecessary friction, the wheel it is flowing upon.

In the common way of constructing mill work and of applying water to wheels, it has been found indispensably necessary to have a head of from 2 to 4 feet above the aperture through which the water flows into the buckets, or against the floats of a water wheel, in order to be able to load the wheel instantaneously, and without which precaution it could not be driven at the required speed; from this circumstance it has been erroneously inferred that the impulse or shock which a water wheel so filled receives, is greater than the power to be derived from the actual gravity of the water alone. This theory I have heard maintained among practical men, but it is, in fact, only resorting to one error to rectify another. Overshot wheels have been adopted in numerous cases merely for the purpose of getting the water more readily into the buckets—but confine the wheel to the proper working speed, and that difficulty does not exist.

In consequence of the excessive speed at which water wheels are generally driven, a small accumulation of backwater either suspends or materially retards their operations, but by properly confining their speed, the resistance from back water is considerably diminished, and only amounts to about the same thing as working from a dam as many inches lower as the wheel is immersed; and in undershot wheels worked from a low head, or situated in the tide-way, the resistance from back water may be farther obviated by placing the floats not exactly in a line from the centre of the wheel, but deviating 6 or 8 inches from it, so as to favour the water leaving the float ascending.

In constructing water wheels to be driven at the speed of 4 to 5 feet per second, it will be requisite to make them broader to work the same quantity of water which is required to drive a quick speeded wheel. Thus if a person intending to erect a mill, has a stream sufficient to work a wheel 5 feet broad, the skirt to move 10 feet per second, it is evident that if he wishes to work all the

water which such wheel takes, he must have his wheel 10 or 12 feet broad, instead of 5, otherwise the water must run to waste, as there would not be room in a slow moving wheel of 5 feet broad to receive more than half of it. The principal advantages resulting from the proposed method of adapting wheels to the falls by which they are to be worked, and the method of applying water, are:

1. The lessening of friction upon the main gudgeons, (and first pair of cog wheels,) by which, with a little care, they may be kept regularly cool, and the shaft or axis be preserved much longer in use than when the gudgeons cannot be kept cool.

2. By working water upon the principle of its actual gravity alone, and applying it always at the height of the surface of the dam, its power is double what is obtained by the common method of applying it.

3. The expensive penstock required to convey the water to the wheels, generally used, will not be needed, as one much shallower, and consequently less expensive, will be sufficient.

4. The resistance of back water is reduced as far as possible.

5. The risk of fire is less, as the friction is reduced.

I shall close this paper with remarks upon those establishments I have inspected in the course of the present year.

Mr. Smith's newly erected corn mill on the Rariton, at New-Brunswick, N. J., has water wheels 16 feet high and 14 feet broad, which are worked by a head of four feet. The water wheels make 12 revolutions per minute, equal to 10 feet per second, when the stones (five feet diameter) make 100 revolutions.

The water wheels at the flour mills at Brandywine, near Wilmington, are worked at the speed of 10 to 15 revolutions per minute, the wheels generally 16 feet high, and the fall 20 feet.

In all these establishments, there is not obtained 50 per cent. of the power of the water used.

The water wheels at Fair Mount, used for supplying Philadelphia with water, are 16 feet high and 14 feet wide, worked by a head of 5 feet; they are driven at the rate of 13 revolutions per minute, which is equivalent to 11 feet per second for the motion of the skirt of the wheel.

The machinery used here, is highly creditable to the workmen who put it up; but if the principle of applying water, which I have endeavoured to establish, be correct, it will be readily perceived, that a very considerable loss of power is sustained by its mode of application.

If these water wheels, as situated at present, were confined to make no more than 5 revolutions per minute, and the pumps to make the same number of strokes that they now do, that is 13 double strokes, the water flowing against the wheel at the surface of the dam; each wheel would work two of the pumps, with the water that is now taken to work one. But if the wheels were placed 18 inches lower in the tide-way, two-thirds of the water required to work one pump, would work two at equal speed, while the wheel continued free, and it would require no more than is now used to

work one pump, to work two with the wheel immersed 18 inches in the tide. This will, I trust, be sufficiently clear, when it is considered, that by the reduced speed, an addition of 150 per cent. in the quantity of water is thrown into the wheel and kept there, together with the advantage gained between the water descending four and one-eighth instead of 11 feet per second.

September 24, 1825. W. PARKIN, Engineer.

STEAM ENGINES.

The subjoined account of the steam engines in use in Glasgow and its vicinity, at the beginning of the year 1825, exhibits a creation of physical force, applied to the purposes of manufacturing, within the short space of thirty-three years, which is well worthy the notice of the city of Philadelphia. The population of the two cities is nearly equal, and the conviction is general, that *we* are well situated for the business of manufacturing, and that our prosperity is intimately connected with its establishment. Besides those manufactures extensively carried on in Glasgow, there is one of vast importance, and which it is in our power extensively to prosecute; the manufacture of broad-cloth and other fabrics of wool, either alone or in mixture. Enough has been done in the United States, to prove that in nearly every department of that business, labour-saving machinery may be employed, with advantages equal to those exhibited in the manufacture of cotton. It is the determination of the Editor to present this subject more fully, in an early number of this journal. as the views which it opens are too numerous and too important, to be dismissed in the compass of a few lines.

The corporation of the city would, it is believed, pursue a policy as wise as it would be liberal, were they for a limited time, to allow the free use of the Schuylkill water, for the supply of all the steam engines, which should be built, and applied to manufacturing purposes, within a certain period. This might be done without any present loss; whilst it would tend to give that activity to industry, value to property, and employment to capital, which would immediately, although indirectly, more than pay the tax; whilst, eventually, a new source of revenue would be opened.

We are wisely lavish in the use of water, in order to preserve the property of our citizens in case of fire. Would not the wisdom be equal, which should freely apply a portion of it to promote the creation of property, which otherwise may never come into existence?

An account of the Steam Engines now employed at Glasgow, and in its neighbourhood. Extracted from "An Historical account of the Steam Engine, and its application in propelling vessels. By Mr. JAMES CLELAND, *superintendant of public works for that city, member of its Chamber of Commerce, &c. &c."*—Glasgow, 1825.

"The first Steam Engine erected in Glasgow, for spinning cotton, was put up in January, 1792, in Messrs. William Scott & Co.'s

(afterwards Tod & Stevenson's) Cotton Mill, near Springfield, nearly opposite what is now the Steam Boat Quay. This was seven years after Messrs. Boulton & Watt put up thei · first Steam Engine for spinning cotton, in Messrs. Robinson's mili, at Papplewick.

Number of Steam Engines in the city of Glasgow and its suburbs, in April, 1825.

Manufacturers' Names.	Horse Power of Engine.	How employed.
Glasgow Water Works, 5 engines, 1 of 70, 2 of 30, 1 of 20, and 1 of 10 horse power, - - - - -	160	Raising Water.
Robert Thomson & Son, 3 engines, 1 of 48, 1 of 25, and 1 of 20. - -	93	Spinning Cotton.
Cranstonhill Water Works, 3 engines of 30 each, - - - -	90	Raising Water.
Corporation of Bakers, 2 engines, 1 of 42, and 1 of 32, - - -	74	Grinding Flour.
J. Bartholomew & Co. 2 engines, 1 of 60, and 1 of 12, - - -	72	Spinning and Weaving.
John Monteith, 3 engines, 1 of 32, 1 of 25, and 1 of 14, - - -	71	Spinning and Weaving.
Claud Girdwood & Co. 2 engines, 1 of 36, and 1 of 25, - - -	61	Engine and Machine Making, Founding and Weaving.
David Todd, 2 engines, 1 of 35, and 1 of 16, - - - -	51	Spinning Cotton.
Macleroy, Hamilton & Co. - -	50	Spinning and Weaving.
John Miller, - - -	48	Spinning and Weaving.
James Corbet & Co. 2 engines, 1 of 32, and 1 of 14, - - -	46	Spinning and Weaving.
Henry Houldsworth, - -	45	Spinning Cotton.
Lancefield Spinning Company, -	45	Spinning and Weaving.
William Auld, 2 engines, 1 of 24, and 1 of 20, - - - - -	44	Weaving and Snuff-making.
Henry Monteith & Co. 2 engines, 1 of 32, and 1 of 10, - - -	42	Printing and Discharging.
James Dunlop, - - -	42	Spinning Cotton.
Thomas Hervey, - - -	40	Distilling.
Charles Todd, 2 engines, 1 of 20, and 1 of 18, - - - - -	38	Weaving.
Muir, Brown & Co. 3 engines, 1 of 20, 1 of 10, and 1 of 8, - - -	38	Bleaching, Dyeing, and Discharging.
Anderson & Co. - - - -	36	Lamp Black Making, and Grinding.
Mile-end Spinning Company, - -	36	Spinning Cotton.
William Hussey, - - - -	36	Spinning Cotton.
Thomas Lancaster, - - -	36	Weaving, Printing, and Discharging.
James Crombie, 3 engines, 1 of 14, 1 of 12, and 1 of 10, - - -	36	Spinning Cotton.
John Wilson, - - - -	32	Spinning and Weaving.
Finlay, Connal & Co. - - -	32	Spinning Cotton.
Couper, Maitland & Co. - - -	32	Spinning and Weaving.
Bogle & Ferguson, - - -	32	Spinning Cotton.
Colin Gillespie, 2 engines, 16 each, -	32	Weaving.
James Oswald & Co. - - -	30	Spinning Cotton.
Charles Tennent & Co. - - -	30	Chymical Operations.
George Buchanan & Sons, 2 engines, 1 of 16, and 1 of 14, - - -	30	Calendering.

William Ewing,	28	Weaving.
James M'Donald,	25	Spinning and Weaving.
Dugald M'Phail,	25	Spinning and Weaving.
James Edington,	25	Founding and Weaving.
George Forster,	25	Spinning and Weaving.
William Clark, 2 engines, 12 each,	24	Weaving.
Reid & Whiteman,	24	Weaving.
Moses M'Culloch & Co.	24	Smith Work and Founding.
George Aitken,	20	Weaving.
John Clark & Co.	20	Spinning Cotton.
William Perry,	20	Spinning and Weaving.
Thomas Edington,	20	Founding and Grain Grinding.
John Glass,	20	Dyeing and Discharging.
William Sim,	20	Grain Grinding.
Douglas Wardrop,	20	Weaving.
M'Lellan & Turner,	20	Weaving.
John M'Ausland,	20	Weaving and Cutting Wood.
Angus Shaw,	20	Spinning Cotton,
Black & Co.	20	Calendering.
Andrew Smith,	20	Weaving.
James M. Graham,	20	Spinning Cotton.
John Black & Co.	20	Calico Printing.
R. F. & J. Alexander,	18	Twisting Yarn.
Wardrop & Hervey,	16	Weaving.
Andrew Campbell,	16	Weaving.
Daniel M'Phail & Co.	16	Spinning Cotton.
Patrick Dawson,	16	Distilling.
John Gourlay & Co.	16	Distilling.
Brown & M'Nee,	16	Weaving.
William Kerr & Co.	16	Calendering.
William Aitken,	16	Spinning Cotton.
Hector Grant,	14	Weaving.
Robert Blackburn & Co.	14	Spinning and Weaving.
Andrew Thomson,	14	Spinning Cotton.
John Barr & Co.	14	Spinning Cotton.
Leishman, Dunlop & Co.	14	Spinning Cotton.
Robert M'Farlane & Co.	14	Distilling.
John Forsyth,	14	Pottery and Fire Brick.
J. & A. Monach,	14	Spinning Cotton.
Rockvilla Mill,	14	Distilling and Grain Grinding.
Stevenson, M'Lean & Co.	14	Calendering.
Reid & Jones,	14	Calendering.
Robert M'Laren,	14	Spinning Cotton.
John Cairnie & Co.	14	Distilling.
Glasgow Foundry Company,	14	Founding.
William Dunn, 2 engines, 1 of 8, and 1 of 6,	14	Machine making and Spinning Cotton.
James Johnston,	14	Weaving.
John M'Lean,	14	Weaving.
Neil Snodgrass,	12	Spinning Cotton.
Anderston Foundry,	12	Machine Making & Founding.
David Napier,	12	Engine Making & Founding.
Francis Marr & Co.	12	Spinning and Weaving.
John M'Aulay,	12	Grain Grinding.
Joseph Scott,	12	Grain Grinding.
James Taylor,	12	Calendering.
Malcolm M'Lean & Co.	12	Calendering.
John Stevenson & Co.	12	Dyeing and Discharging.
James Cook,	12	Engine and Machine Making.
H. & R. Baird,	12	Engine Making & Founding.

Robert Napier, - - - -	12 - Engine Making & Founding.
Hamilton Garden, - - - -	12 - Raising Water.
Archibald Turner, - - - -	10 - Spinning Cotton.
Bowman Fleming, - - - -	10 - Bleaching and Dyeing.
Blair & Morrison, - - - -	10 - Calendering.
Crawford & Co. - - - -	10 - Calendering.
Ure & Bankier, - - - -	10 - Calendering.
Murdoch & Cross, - - - -	10 - Engine Making & Founding.
Samuel Wilson, - - - -	10 - Sugar Refining.
Malcolm Muir & Co. - - -	10 - Veneer Sawing.
Dr. Drew, - - - -	10 - Bleaching and Dyeing.
J. & M. Mitchell & Co. - - -	10 - Tambouring.
George M'Intosh & Co. 2 engines, 1 of 6, and 1 of 3, - - -	9 - Chymical and Cudbear Operations.
Anderston Brewery, - - -	8 - Grinding Malt and Pumping Worts.
Donald M'Donald, - - -	8 - Spinning Cotton.
Mrs. M'Kinlay, - - - -	8 - Fire Brick Making.
Watt & Archibald, - - -	8 - Turning and Cutting Wood.
Walter M'Queen, - - - -	8 - Bleaching and Dyeing.
John M'Kay, - - - -	8 - Wool-Carding.
Alexander Herbertson, - - -	8 - Weaving.
James M'Nair, - - - -	8 - Sugar Refining.
Robert Struthers, - - - -	6 - Grinding Malt and Pumping Worts.
Archibald Liddell, - - - -	6 - Grinding Colours.
William M'Andrew, - - -	6 - Engine Making & Founding.
Duncan M'Arthur, - - -	6 - Engine Making.
John Geddes, - - - -	6 - Glass Grinding.
Archibald Geddes, - - - -	6 - Glass Grinding.
Andrew King, - - - -	6 - Weaving.
John Neilson, - - - -	6 - Engine Making.
Pollock & Blackie, - - -	6 - Founding.
John Roberton, - - - -	6 - Founding.
Charles Gray, - - - -	6 - Distilling.
James Fleming, - - - -	6 - Bleaching.
James M'Dougal, - - - -	6 - Calico Printing.
George M'Leod, - - - -	6 - Grinding Drugs.
John M'Intyre, - - - -	6 - Smith Work and Founding.
Parlane & Ure, - - - -	6 - Calendering.
A. M'Lellan & Son, - - -	6 - Coach Making.
William Bryden & Co. - - -	6 - Coach Making.
Stephen Miller & Co. - - -	6 - Founding.
William Brown & Co. - - -	6 - Grinding Colours.
Samuel Hall & Co. - - -	6 - Singeing Muslins.
William Watson, - - - -	6 - Engine and Machine Making.
Thomas Baird & Son, - - -	6 - Dyeing and Printing.
Walter Stewart & Co. - - -	6 - Grinding Malt and Pumping Worts.
Connal & Co. - - - -	6 - Distilling.
Port-Dundas Foundry, - - -	4 - Founding.
Archibald Arthur, - - -	4 - Printing and Grinding Indigo.
Gow & Co. - - - -	4 - Bleaching and Dyeing.
Gas Work, - - - -	4 - Gas.
J. & H. Wardrop, - - - -	4 - Coppersmiths.
Apothecary Company, - - -	4 - Grinding Drugs.
Matthew Balmanno, - - -	4 - Grinding Drugs.
John Roxburgh, - - - -	4 - Tanning.
John Bell, - - - -	4 - Fire Brick Making.
John Fulton, - - - -	4 - Founding.

John M'Donald & Sons,	4	Dyeing and Discharging.
John Spence,	3	Smith Work.

Total,—Manufacturers, 149.—Engines, 176.—Horse Power, 2970.

Average power of Engines, $16\frac{875}{1000}$.

Abstract.—*Horse power, how distributed.*

	Horse power.		Horse power.
Spinning Cotton,	893	Brought forward	2809
Weaving,	665	Smith Work,	18
Raising Water,	262	Grinding Drugs,	14
Bleaching, Dyeing, Printing, and Discharging,	206	Coach Making,	12
Calendering,	154	Glass Grinding,	12
Grain Grinding,	153	Grinding Malt and Pumping Worts,	20
Founding,	124	Grinding Colours,	14
Distilling,	119	Veneer Sawing,	10
Engine Making,	62	Tambouring,	10
Chymical Operations,	39	Cutting Wood,	18
Machine Making,	37	Wool Carding,	8
Snuff Making,	22	Pottery,	7
Fire Brick Making,	19	Singeing Muslin,	6
Sugar Refining,	18	Gas,	4
Lamp Black Making,	18	Coppersmith,	4
Twisting Yarn,	18	Tanning,	4
Carried forward,	2809	Total,	2970

The above exhibits the horse power employed in Spinning and Weaving in Glasgow and its Suburbs, extending not more than two miles from the Cross, but gives no idea of the power employed in the Cotton trade at a greater distance, by Glasgow Manufacturers; Messrs. Robert Owen & Co.'s establishment at New Lanark, James Finlay & Co.'s at Deanston, Ballandalloch, and Catrine, and William Dunn's at Duntocher, Paisley, and Milton, alone contain Water Twist and Mule Spindles, equal to 236,000 of the latter description. If the works of Messrs. Henry Monteith & Co. at Blantyre—Wm. Kelly, at Rothsay and Blackburn—and of the other great Manufacturers belonging to Glasgow were taken into account, the extent of business done at these establishments would be shown to be much greater than is generally understood.

Number of Steam Engines employed in Collieries in the neighbourhood of Glasgow.

	Horse power.
Clyde Colliery, 3 pumping engines, 1 of 64, 1 of 54, and 1 of 16; 6 winding engines, 2 of 18 each, and 4 of 11 each. This power includes Hamilton Farm Colliery,	214
Govan Colliery, 2 pumping engines, 1 of 54, and 1 of 42; 1 pumping and winding, 20; 4 winding, 1 of 18, 2 of 14, and 1 of 9; 1 rotatory engine, 16,	187
West Muir Colliery, 2 pumping engines, 1 of 78, and 1 of 58; 3 winding engines, 2 of 16 each, and 1 of 10,	178
Eastfield Colliery, 2 pumping engines, 1 of 72, and 1 of 54; 2 winding engines, 1 of 23, and 1 of 14,	163
Old Farm Colliery, 1 pumping engine, 72; 2 pumping and winding engines, 19 each; 2 winding engines, 1 of 18 and 1 of 10. This power includes Wellshot Colliery,	138
Stonelaw Colliery, 2 pumping engines, 1 of 51, and 1 of 35; 3 winding engines, 14 each,	128
	1008

	Horse power.
Brought forward, - -	1008
Knightswood Colliery, 1 pumping engine, 56; 3 winding engines, 2 of 10 and 1 of 8, - - - - - - - - - - -	84
West-thorn Colliery, 1 pumping engine, 26; 3 winding engines, 1 of 14, and 2 of 13 each, - - - - - - - - - - -	66
Dalmarnock Colliery, 1 pumping and winding engine, 18, and 1 pumping, 46, - - - - - - - - - - -	64
Barrowfield Colliery, 2 pumping and winding engines, 1 of 26, and 1 of 14; 1 pumping engine of 20, - - - - - - - -	60
Prockiemuir Colliery, 1 pumping engine, 29; 1 winding engine, 12, -	41
Gairbraid Colliery, 1 pumping engine, 18; 2 winding, 1 of 8, and 1 of 4,	30
Dalbeth Colliery, 1 pumping and winding engine, - - - -	24
Belvidere Colliery, 1 pumping and winding engine, - - - -	22
Hillhead Colliery, 1 pumping engine, - - - - - -	8
East Woodside Colliery, 1 pumping and winding engine, - - -	4
Total, - -	1411

Total,—Collieries, 18.—Engines, 58.—Average power of Engines, $5\frac{327}{1000}$.

Steam Engines in Stone Quarries.

	Horse power.
Westmuir,..........	11
Garscube,..........	6
Kelvinholme,..........	6
Firework,..........	4
Possil,..........	4
Kelvinhaugh,..........	4
Eastfield,..........	4
	39

Total,—Quarries, 7.—Engines, 7.—Average power of Engines, $5\frac{571}{1000}$.

GENERAL ABSTRACT.

	Number of Engines.	Horse power.
In Manufactures,..........	176	2970
In Collieries,..........	58	1411
In Stone Quarries,..........	7	39
In Steam Boats,..........	68	1926
In Clyde Iron Work,..........	1	60
Totals,..........	310	6406

Average power of Engines, $20\frac{664}{1000}$.

The difference of cost between the price of coals consumed by Steam Engines and the keep, &c. of horses, must ever vary with circumstances. The following will give some idea of the difference:—A heavy horse, working ten hours, will consume 15 lbs. avoirdupois of oats, and 14 lbs. of hay per day—an Engine of 30 horse power, working 10 hours per day, in a mill, will consume, on an average of summer and winter, about 4 tons of coal dross. The Steam Boat, Toward Castle, from Glasgow to Rothsay and back again, a distance of about 80 miles, consumes five and a half tons of hard coals in 12 hours.

ON VARIOUS CEMENTS.—By Thomas Gill.

Yates's Water-Proof Glue or Cement.

Take of the best Irish glue, four ounces; and of isinglass, two ounces: these must be dissolved in mild ale (*not stale*,) over a slow fire, in a common glue-kettle, to the consistence of strong glue; when one ounce and a half of well-boiled linseed oil must be gradually added, and the whole well incorporated together by stirring. To increase the strength of the glue, more isinglass may be added.

This cement is applicable to the joints of wood, in every branch of manufacture; as also to joining earthenware, china and glass—care being taken to press the parts well together, and to allow them sufficient time to set.

The cement, when cold, and made into cakes, assumes the appearance of India-rubber; and like it, is elastic. It may at any time, when wanted for use, be dissolved, by a gentle heat, in any proper iron or glazed earthen-vessel; first putting into it a little mild ale, to prevent it from burning at the bottom of the vessel; and adding more ale, to bring it to a proper consistence for use. To cement leather together, for harness, bands for machinery, &c., having prepared the joints in the usual way, as if for sewing, apply the cement while hot, laying a weight upon each joint, as it is made: let them remain six hours before using, and the joints will then become nearly as firm as if made of one entire piece of leather. An excellent cement for stopping leaks in casks, &c. may be made by putting a little tow to the other ingredients.

Glue and Rosin Cement.

Two parts of glue and one part of rosin are to be melted together; and a sufficient quantity of red-ochre added, to colour it.

This cement is used to cement hones into their wooden-frames, and appears likely to be useful for many other purposes.

Glue and Linseed-Oil Cement.

Strong glue, well made with water, one pint; and one-eighth of a pint of linseed oil added to it, drop by drop, whilst boiling.

With this glue or cement, the joiners unite the parts of sign-boards, or other works which are to resist the effects of moisture.

On the Gum-Ammoniacal Cement.

This cement is formed by adding to a solution of gum-ammoniac in proof-spirit, some isinglass or parchment-glue, and uniting them in a gentle heat.

The chief value of this cement consists in the great readiness with which it melts in a small degree of heat, and the little tendency it has to be affected by moisture.

This cement is very much employed by entomologists, in joining together the dislocated parts of insects; for which purpose it is exceedingly convenient.

Isinglass Cement.

Isinglass, dissolved in brandy or proof-spirit, readily melts by a gentle heat, and forms a very useful and convenient cement.

Cement of Isinglass and Gum-Arabic.

This cement is composed of two parts of isinglass, and one part of the best gum-arabic, put into a bottle, and covered with gin or proof-spirit; and the bottle being loosely corked, is to be placed in a vessel of water, and boiled till the solution is effected; which may then be strained for use.

In this valuable cement, the isinglass and gum-arabic correct each other's defects; the isinglass giving to the gum toughness, and the gum increasing the hardness of the isinglass; and both together forming a most useful cement, particularly for mounting opaque objects for the microscope.

On the use of Wafers, as an extemporaneous Cement.

A great improvement in the manner of using wafers, so as to cause them to unite or hold papers together more firmly and neatly, is to divide or split them with a pen-knife, and thus to form two wafers out of one, of only half the usual thickness. These may be cut into small pieces, and applied by first wetting the paper in the places to be cemented, and laying a piece of wafer on each; and then wetting the pieces of wafer, over which the other paper to be united may be placed, and pressed close: thus perfectly effecting the union. A very cheap cement is thus readily obtained; and with white wafers, owing to the thinness of the split wafer, no marks will be seen, as is the case where the entire wafer is used: the union also is so perfect, as to render separation impossible, as is sometimes effected by splitting the entire wafer.

Improved Gum-Water.

It is well known that the mucilage of gum-arabic is exceedingly liable to become spoilt by keeping. If, however, the gum be dissolved in water, and made of a thick consistence, and a little alcohol added to it, that evil will be prevented; or the solution may be made at once, in gin or other proof-spirit.

This gum-water should be kept in a wide-mouthed glass vessel, with a ground stopper, to prevent the escape of the alcohol. And although it has not the strength of the above described cement, which is composed of gum-arabic and isinglass, yet it is very serviceable for many purposes, especially as it does not require to be heated before using.

A very convenient way of applying it to the cementing of small labels on specimens of minerals, &c. is, by forming an instrument of a small common pin, stuck a little way into a slender pointed han-

* A good cork is much better, as the stopper will become firmly cemented. —EDITOR.

dle of wood: the head of the pin, on being dipped into the gum-water, takes up a sufficient quantity at a time: and it may then be applied, in a small spot, to each end of the label, which is generally sufficient to secure it to the specimen.

On Shell-lac, as a Cement.

This article is largely employed by the hair-workers in jewellery, to cement the hair into the collets, and thus to form it into bracelets, &c. The mode of using it is as follows:—The shell-lac is put into a basin, and the basin placed in a Dutch-oven, which is set before an open fire, until the shell-lac becomes melted by the effects of the gentle heat thus applied, and can be drawn out into slender threads or rods fit to enter the small collets.

To use it, the collets must be warmed sufficiently to melt the shell-lac, *but not more;* as its utility greatly depends upon the volatile parts being preserved, which are quickly dissipated by too great heat. The hair is then to be placed within the collets, and thus firmly secured.

In like manner, with shell-lac, the ruby cylinders of watches are firmly cemented in their sockets, by the watch-jewellers.

On Copal, Amber, or Gum-Mastich, as extemporaneous Cements.

These substances may be employed in their natural state, much in the same way as the shell-lac, forming exceedingly hard and durable cements. The jewellers use the last-mentioned article in uniting the two stones which form their *doublets;* although it would seem that copal would much better answer that purpose, from its greater hardness. Amber, also, where its colour is no objection, is yet fitter than either to effect this object, on account of its still greater strength.

On Glue, as an extemporaneous Cement.

This article, sawn into slips, is of great use to artists, in cementing paper, vellum, &c. to their drawing boards, in the following manner.

The paper, &c. being damped upon its back, by means of a wetted sponge, and laid upon the drawing-board, the end of the slip of glue is to be dipped into hot water, and rubbed between the edges of the paper and the drawing-board, so as to apply a slight coat of stiff glue to both: the paper is then to be rubbed down hard upon the board, until the union is effected; and, in case of the paper becoming loosened in places by its stretching and tightening as the water evaporates, the same process is to be repeated.

When the drawing is completed, the paper, vellum, &c. may be readily taken off the board, by inserting an ivory folding-knife between it and the board. And what little still remains adhering to the board, may be removed, previously to cementing another paper upon it, with a sponge and hot water.

Varley's Cement.

Take sixteen parts, by weight, of black rosin, the same quantity of whiting, and one thirty-second part of bees-wax.

The whiting finely powdered, must be previously heated red-hot, to expel all moisture; and be suffered to cool, before adding it to the melted rosin and bees-wax.

This cement is exceedingly useful in the various mechanical arts, and particularly in turning in general, for the purpose of cementing articles to chucks, &c. in the lathe. It is also used in watch-jewellery, to hold the rubies, &c. fast, in turning and drilling them in the lathe: for this purpose, however, Mr. Seymour, formerly a workman of Mr. Varley's, thinks that *chalk* in its natural state, finely powdered, is preferable to the washed chalk or whiting; and he also varies the proportion of the bees-wax, according to the warmth or coldness of the weather.

It will be seen that the *rosin* forms the chief binding ingredient in this cement; the bees-wax being added merely to give it toughness.

Glue from Tanned Leather.

It is generally thought that the process of tanning, renders leather exceedingly insoluble. Means, however, have been found to overcome that insolubility, and to form a glue exceedingly well adapted to the purpose for which it has hitherto been used; namely, that of making the *black paper cases*, so much used for a great variety of purposes; as it not only forms the cement by which they are glued together, but also, in consequence of the gallic-acid contained in it, strikes a black colour, by the application of a solution of sulphate of iron (green vitriol, or copperas) to the surfaces of the articles; and lastly, serves to varnish the cases.

The process for making this glue is as follows:—Boil the scraps or cuttings of thin tanned leather; such as the upper leathers of boots, shoes, &c. are made of, in stale urine, until they become softened, and will stretch and contract, when pulled and let go again, in the manner of India-rubber: they are then to be washed in clean water, and boiled in water until dissolved to a proper consistence for use.

It is very singular that this useful process has been hitherto confined to the above branch of manufacture; and has never, to the best of the Editor's knowledge, been before published.

*On the French Glue from Bones.**

This is made at Paris, by M. Robert, in the following manner: The bones used, are those only which, previous to this discovery, answered no useful purpose except for the fabrication of phosphorus, ammonia, animal charcoal, bone-ashes, or manure; such, for in-

* Extracted, with alterations, from Silliman's Journal of Science and the Arts.

stance, as those of the head, ribs, &c. The refuse of the legs of sheep and calves, &c. which had been already partly used for the purposes of the toy-men, (*tabletiers*) are also used for this purpose, after extracting as much of the gelatine and fat as can be done by ebullition. When the heads of oxen are to be operated upon, they begin by extracting the teeth, (these being reserved for the fabrication of ammonia, as affording a greater proportion of that alkali than any of the other bones:) they then break the skull, in such a manner as to preserve all the compact parts in as regular forms as possible; these pieces present a surface of from twenty to thirty inches square, and are put to soak in a mixture of muriatic acid and water. The muriatic acid used, marks about 23° of the *areometer*, and is diluted by water to about 6°. Four parts of the liquor is used to one part of the bones. They are left in this state, in open vessels, until a complete solution of the phosphate of lime has taken place, and the gelatinous part of the bone remains in its original shape and size, and is perfectly supple. When this operation is finished; which commonly lasts six or eight days, the gelatine is put into baskets, being first drained; and is immersed a short time in boiling water, in order to extract any small remains of grease, which would deteriorate the gelatine; and also to extract any of the acid which might be lodged in the pores. It is then carefully wiped with clean linen, and afterwards washed in copious streams of cold water, to whiten it, and render it more transparent: it is then put to dry in the shade. This is used for making glue of a very superior quality.

The inside of the bones of sheeps' legs, furnish a sort of membranous glue, which supplies with advantage, the place of isinglass, in the fabrication of silk stuffs.

Remarks on this Process.

Glue is generally made in this country, as is well known, from the skins of animals. The Editor would, however, wish particularly to call the attention of persons to the great superiority, in point of strength, of the glue made from bones, over the best English glue; as appeared from various trials made with it by a skilful English workman at Paris, in comparison with that of the best glue made in England; and on the result of whose experiments he has every reason to place absolute confidence. It surely is highly necessary that endeavours should be made in this country, with a view of re-establishing the preference hitherto shown to the English glue: and, indeed, there has lately been a Patent taken out for a new method of manufacturing glue from bones, by means of steam.

On the Processes of Tanning, Leather-Dressing, and Dying, &c. from Aikin's Dictionary of Chymistry.

The preparation of the skins of animals for the many important purposes to which they are applied, is, almost exclusively, in all its branches, a chymical process.

The art of preparing leather is unquestionably one of the most ancient known, and is practised in every country on the face of the globe, with a general similarity of method, the result of obvious reasoning and long experience.

The objects fulfilled in converting skin into leather, are to prevent the destruction by putrefaction, which unprepared skin would undergo, (though slower than with most other parts of animals) and to render it strong, tough, and durable, and in some instances impervious to moisture.

The recent skin stripped off an animal, consists principally of the true cutis, or membraneous texture; the chymical composition of which is gelatin in a dense state, but still entirely soluble in water, more or less easily, according to its density. This however is penetrated with different vessels for blood, lymph, oil &c., some of the contents of which, must of necessity, remain after the death of the animal, and is covered on the outside with the insensible cuticle, to which is attached the exterior covering of hair, wool, fur, and the like. The chymical composition of the cuticle and its investing hairy covering, appears to be condensed albumen, insoluble in water, and nearly incapable itself of putrefaction, but readily separable from the true skin by slight mechanical violence, after the adhesion has been weakened by incipient fermentation or putrefaction, or the chymical action of lime, alkalies, or acids.

The preliminary steps of all the processes for making leather consist in separating from the cutis, adhering impurities and foreign matters, the animal juices retained in its pores, and the cuticle with its hairy covering; (except in the very few cases, in which the latter is purposely left on.) The true skin being thus obtained nearly pure, and its texture so far opened as readily to imbibe any substance in which it is macerated, is then converted into leather in different methods, of which there are two quite distinct from each other; namely, that of *tanning*, or impregnating it with the peculiar vegetable matter called tan; and *tawing*, in which it imbibes alum and other salts, and afterwards some soluble animal matter, such as the white of egg, or sometimes blood. These two processes are also sometimes combined, that is, first by tawing, and afterwards finishing with a slight tanning. A large portion of the tanned leather also undergoes the farther operation of *currying*, or imbuing with oil of some kind, with much manual labour, in order to render it supple, flexible and still more impenetrable by water. As familiar examples of each, the thick sole leather of shoes is *tanned;* the white kid leather, as it is called, for fine gloves, is *tawed*; the upper leather, for boots and shoes, is *tanned* and *curried*; and the fine Turkey leather is *tawed*, and afterwards finished with a slight *tanning*.

The slight variations in the preparation of different kinds of leather, are so numerous, that only some of the leading processes can be here described.

Tanned Leather.—All the skins undergo a considerable pre-

paration before they are fit to receive the tanning lixivium. In most parts of England the process is the following, for the thin skins of cows, calves, and those that are used for the more flexible kinds of leather; most of which is afterwards finished by currying: the hide is first thrown into a pit with water alone, to free it from loose dirt, blood, and other impurities. After lying there for a day or two, it is placed upon a solid half-cylinder of stone, called a *beam*, where it is cleared of any adhering fat or flesh. It is then thrown into a pit containing lime and water, in which it is kept for several days, with frequent stirring. The use of this is to loosen the hair and cuticle; after which the hide is again stretched on the beam, and the hair entirely scraped off with a blunt knife made for the purpose.* The hide being well freed from the lime, is then put into a pit called the *mastering*-pit; which is a bath composed of water and the dung of some animal, generally hens, or pigeons, or dogs, or, where it can be had, of sea-fowl, diffused through the water. The dung of horses or cows will not answer, not being sufficiently putrescent. Here the hide remains for some days, more or less, according to its texture; and from being hard and thick, (the effect of the lime-water,) it becomes very soft and supple. Where the hide is very thin and fine, extreme care is requisite in regulating this part of the process; for the putrescent dung is found so powerful an agent, that if the skin is kept in it only a few hours too long, its texture is irrecoverably destroyed, and it is reduced to a gelatinous mass, which pulls to pieces with the slightest force. The hide is then thoroughly cleaned on the beam, and is fit for tanning.

The large thick ox or boar's hides, intended for the toughest sole-leather, or where a very strong leather is required, are prepared in a different way. Being first cleaned in water, they are sometimes rolled up in heaps, and put into a warm place, where they speedily begin to putrify. The hair is then loosened, and may be scraped off sometimes with, and at other times without, the process of liming. The reason why the liming is generally omitted is, that the lime, if retained in the skin, renders it too hard, and liable to crack; and it is not so easy to wash it out from these, as from the thinner hides. But on account of the thickness of the hide, and the closeness of its texture, it is not fitted to receive the tan liquor till its pores are more completely opened; and this is usually done, by immersing it for several days in a vat

* In some tanneries the hair is loosened without the use of lime, the skins are piled together and covered with spent bark; in this situation, a fermentation takes place, which so far decomposes the cuticle, as to allow the hair to be easily scraped off. This is found to be a great improvement, but great care is required in its management, for if the fermentation is allowed to proceed too far, the texture of the skin will be injured. The length of time required for the completion of this process, varies with the weather and other circumstances; the pile is frequently examined, and the skins removed, as soon as the hair is loosened. Not the slightest injury is produced, and the business is greatly facilitated.—Editor.

containing a sour liquor, an impure acetous acid, formed from rye or barley flour, strongly fermented. The acid generated in the process, seems to be a principal agent in opening the texture of the skin; but this is, doubtless, assisted by the continuance of the fermentation, of which the skin itself partakes. This process is called *raising*, and it always immediately precedes that of tanning. Here, also, much care is required not to weaken the texture of the skin too much, for if kept too long in this process, it would be corroded and spoiled. The hide comes out of this bath considerably swelled and softened.

Instead of this part of the process, which is often difficult to manage properly, on account of the effect of the weather, and other external causes, on the necessary fermentation; Dr. Macbride has proposed the use of sulphuric acid, extremely diluted, and this appears now to be pretty generally adopted. The proportions employed, are about a wine pint of oil of vitriol to fifty gallons of water. Though the vitriolic bath is found to have as good an effect as the rye and barley sourings, in preparing the hide for the tan, the action of the two substances seems to be considerably different. In the latter the acetous acid is doubtless the chief agent, but the fermentation still continues, as is proved by the readiness with which the skin are rotted, if this is too high, or too long continued. The skin also, after raising in this way, is thickened and softened. But the vitriolic bath is incompatible with any fermentation, and most powerfully checks this process, and hence the skin is not readily spoiled by very long immersion, and it comes out thickened and hardened. It should seem, however, that each method answers perfectly well.

The next process is that of *tanning;* which is essentially the same for all skins, however previously prepared; and is founded on the following chymical facts. A great variety of vegetable substances, that is, all those that give an astringent taste when chewed, (such as the bark of oak, willow, alder, and many other trees, the gall-nut, tea-leaves, &c. &c.) when macerated in water, hot or cold, yield to this menstruum a substance, eminently astringent, of a grayish white when pure, which is called *tannin* or *tan*. When any kind of skin is immersed in an infusion of tan, it gradually absorbs or extracts it from the water in which it is dissolved, and the skin thereby becomes of a firmer texture, sensibly heavier, no longer capable of putrefaction or any spontaneous change, less easily pervious to water, and no longer soluble in this fluid, even at a boiling heat, which all untanned skin is, whatever be its previous preparation. The art of tanning, therefore, essentially consists in nothing more than immersing skin, for a sufficient length of time, in an infusion of tan from vegetable bark, or other sources, till it is completely saturated with this principle. Hence, the art of preserving the hides of animals by this method, is one of the most ancient and universal of all manufactures; no apparatus whatever being required to perform it, except a pit or hole for water, in which the tanning vegetable may be

put, and the skin, thrown in along with it. And even in the most careful and improved methods of tanning, almost equal simplicity is observed in the operation, except that some art is used in regulating the strength of the tan-infusion, and some little manipulation in stirring the hides, to give every part an opportunity of being thoroughly and equally soaked.

The substance used for tanning in this country is almost invariably oak-bark. The timber being felled in spring, (when the sap has risen,) the bark is stripped off, and piled in large stacks, protected from the wet by a shed; but open at the sides, to admit a free circulation of air through it. The bark, before using is ground into coarse powder, and is thrown into pits, with water, by which an infusion of the tan, and other soluble parts is made, which is technically called *ooze*. The hides, previously prepared in one or other of the ways above mentioned, are then first put into small pits, with a very weak ooze, where they are allowed to macerate for some weeks, with frequent stirring, or *handling*, as it is called. The strength of the different oozes is increased gradually, after which the half-tanned hides (if of the thick kind intended for sole leather, and which require very complete tanning) are put into larger pits, with alternate layers of ground bark, in substance, till the pit is filled, over which a heading of bark is also laid, and the interstices filled up with a weak ooze to the brim. The hides are thus exposed to the full action of an ooze nearly saturated with tan, and supplied with more of this principle from the bark in substance, in proportion as the skin absorbs that portion already dissolved, till the tanning is judged to be complete. This, for the heaviest kind of leather, requires never less than fifteen months. Skin is known to be fully tanned by cutting a small piece off the edge of the hide and observing the change of colour. As far as the tan has fully penetrated, the colour is of a nutmeg-brown, but the rest is white; and therefore, before the process is complete, the upper and under sides are brown, and a white line or streak is seen in the middle.

[TO BE CONTINUED.]

GLAZING EARTHENWARE.

M. Rochinski, a manufacturer of earthenware at Berlin, has found a varnish or glazing for common pottery, which, after trials made in the presence of the College of Medicine, offers no danger in regard to health, and resists the action of acids. This glazing is composed of five parts of litharge, two parts of well purified clay, and one part of sulphur. These substances are pulverised, and mixed with a sufficient quantity of caustic alkaline lie, (soapmaker's liquor,) so as to form a mixture fit to be readily applied on the earthenware, and to cover it equally all over. Carefully baked, these wares offer no trace of lead.

COMPOUNDS OF METALS.

An excellent practical work has been recently published in England, entitled "The Operative Mechanic & British Machinist, by *John Nicholson*, Esq. Civil Engineer." From this we shall frequently make extracts for the pages of our Journal; as, by so doing, we shall diffuse valuable information, on many important operations in Mechanics, given by a gentleman who, evidently, well understood the subject upon which he has undertaken to write.—The following receipts are from the appendix, to the above mentioned work.

Fusible Metal. No. 1.—4 parts of bismuth,
$2\frac{1}{2}$ parts of lead, and
$1\frac{1}{2}$ parts of tin.

Put the bismuth into a crucible, and when it is melted, add the lead and tin. This will form an alloy, fusible at the temperature of boiling water.

No. 2.—1 part of zinc,
1 part of bismuth, and
1 part of lead.

This alloy is so very fusible, that it will melt and remain in a state of fusion, if put upon a sheet of paper, and held over the flame of a candle or lamp.

No. 3.—3 parts of lead,
2 parts of tin, and
5 parts of bismuth,

Will form an alloy fusible at 197° Fahrenheit, peculiarly applicable to casting, or the taking of impressions from gems, seals, &c. In making casts with this and similar alloys, it is necessary to use the metal, at as low a temperature as possible; otherwise the moisture adhering to the things from which the casts are to be taken, forms vapour, and produces bubbles. The fused metal should be poured into a tea-cup, and allowed to cool, till just ready to set at the edges, when it must be poured into the mould. In taking impressions from gems, seals, &c. the fused alloy should be placed on paper or pasteboard, and stirred about till it has, by cooling, attained the consistence of paste, at which moment the die, gem or seal, should be stamped on it, and a very sharp impression will then be obtained.

Bath Metal is a mixture of $4\frac{1}{2}$ parts of zinc, with
16 parts of brass.

Brass is composed of 3 parts of copper, and
1 part of zinc.

But brass that is to be cast into plates, for the purpose of making sheet brass, and of drawing into wire, must, instead of using the zinc in a pure state, be composed of
56 parts of the finest calamine, or ore of zinc, and
34 parts of copper.

Old brass, which has been frequently exposed to the action of fire, when mixed with the copper and calamine, renders the brass far more ductile, and fitter for the making of fine wire, than it would be without it; but the German brass, particularly that of Nuremberg, is, when drawn into wire, said to be far preferable to any made in England, for the strings of musical instruments.

Pinchbeck. No. 1.—5 parts of pure copper, and
1 part of zinc.

The zinc must not be added till the copper is in a state of fusion. Some use only half this quantity of zinc, in which proportion the alloy is more easily worked, especially in the making of jewellery.

No. 2.—1 part of brass,
2 parts of copper,

Fused together, under a covering of charcoal dust.

Prince's Metal. No. 1.—3 parts of copper, and
1 part of zinc,
Or, 8 parts of brass, and
1 part of zinc.

No. 2.—4 parts of copper, and
2 parts of zinc.

In this last, the copper must be fused before the zinc is added. When they have combined, a useful and beautiful alloy is formed, called Prince Rupert's Metal.

Bell Metal. No. 1.—6 parts of copper, and
2 parts of tin.

These proportions are the most approved for bells, throughout Europe, and in China. In the union of the two metals, the combination is so complete, that the specific gravity of the alloy is greater than that of the two metals, in their uncombined state.

No. 2.—10 parts of copper, and
2 parts of tin.

It may, in general, be observed, that a less proportion of tin is used for making church-bells, than clock-bells; and that a little zinc is added for the bells of repeating watches, and other small bells.

Tutania, or Britannia Metal.

No. 1.—4 parts of sheet brass, and
4 parts of tin; when in fusion, add
4 parts of bismuth, and
4 parts of regulus of antimony.

This is the composition or hardening, that is to be added at discretion, to melted tin, until it has required the requisite degree of colour and hardness.

No. 2.—Melt together 2 parts of sheet brass,
2 parts of tin,
2 parts of bismuth,
2 parts regulus of antimony.
2 parts of a mixture of copper and arsenic, either by cementation or melting.

This composition is to be added, at discretion, to melted tin.

No. 3.—1 part of copper,
1 part of tin, and
2 parts regulus of antimony, with or without a little bismuth.

No. 4.—1 part of sheet brass,
4 parts regulus of antimony, and
20 parts of tin.

German Tutania.—½ a part of copper,
2 parts regulus of antimony, and
24 parts of tin.

Spanish Tutania. No. 1.—4 parts of scrap iron, or steel,
8 parts of antimony, and
1½ parts of nitre.

The iron or steel must be heated to a white heat, and the antimony and nitre must be added in small portions. Melt and harden 1 lb. of tin with two oz. of this compound.

No. 2.—Melt together 1 part of antimony,
¼ of a part of arsenic, and
8 parts of tin.

The first of these Spanish alloys would be a beautiful metal, if arsenic were added.

Engestroom Tutania.—4 parts of copper,
8 parts of regulus of antimony, and
1 part of bismuth.

When added to 100 parts of tin, this compound will be ready for use.

Queen's Metal. No. 1.—9 parts of tin.
1 part of bismuth,
1 part of antimony, and
1 part of lead.

This alloy is used for the making of tea-pots, and other vessels, which are required to imitate silver. It retains its lustre to the last.

No. 2.—100 parts of tin,
8 parts of regulus of antimony,
1 part of bismuth, and
4 parts of copper.

White Metal. No. 1.—20 parts of lead,
12 parts of bismuth, and
1 part of regulus of antimony.

No. 2.—16 parts of regulus of antimony,
4 parts of brass, and
5 parts of tin.

Common Hard white Metal.
32 parts of brass,
3 parts of zinc, and
1 part of tin.

Tombac.—16 parts of copper,
1 part of tin, and
1 part of zinc.

Red Tombac.—11 parts of copper, and
1 part of zinc.

The copper must be fused in the crucible before the zinc is added. This alloy is of a reddish colour, and possesses more lustre, and is of greater durability, than copper.

White Tombac.—Copper, and
Arsenic,

Put together in a crucible, and melted, covering the surface with muriate of soda, (common salt) to prevent oxidation, will form a white brittle alloy.

Query, on Tinning old Iron Vessels.

Mr. Editor.—Can you, or any of your readers inform me, whether any person in this city will undertake to restore the tinning upon cooking vessels of iron, from which it has been rubbed by use? The operation is, I know, easily performed on copper, but I have not been able to get the workmen to undertake it on iron, some of them have declared it to be impossible. Is this correct, and why? W.

PROPAGATING FRUIT TREES BY GRAFTING.

The best luting wherewith to cover the newly grafted scions, is composed of equal quantities of train oil and rosin, prepared in the following manner:—First, melt the rosin in an earthen vessel; then pour in the oil, and mix them well; to be applied, when cold, with a painter's brush. This composition is used in the north-west part of France (Bretagne) with great success. It has this advantage, that it never cracks, nor admits rain or wind to the grafts, which is the usual cause of their failing. It is more expeditiously put on than the common clay covering, and looks much neater; but what renders it more useful is, that the grafts covered with this composition, seldom fail. Scions laid under earth, or steeped in water for a few days, grow better than those taken from the parent tree. Grafting cherry or pear trees, should not be delayed later than the 17th of March.

Method of Moulding Figures in Wood, called Ligneous Stucco.

A clear size is to be made of five parts of Flanders, and one of fish glue, which are put separately into water, and mixed together, after having passed through a linen cloth, or fine sieve. The quantity of water cannot be stated, because all glues are not of the same strength; the sufficient degree of liquidity is only known by letting

the mixture get quite cold, when it should become a stiff jelly. A few trials will show the proper degree of strength. The glue thus prepared, should be heated until it becomes painful to hold the finger in it; a paste is then to be made of the dust of the wood intended to be moulded.

The dust should be made either with a fine rasp, or with the shavings of the wood dried in an oven, and pounded; or with saw-dust sifted through a fine sieve. This paste is to be laid two or three tenths of an inch thick, in a mould of plaster or sulphur, the surface having been rubbed with linseed or other oil, in the same manner as when mouldings are taken in plaster. While this first paste is drying, another is preparing with the dust of the wood, which has not passed through the fine sieve, but through a coarse one. The mould is to be entirely filled with this second paste, which gives consistency to the first; it is then to be pressed heavily, so that the paste may receive all the forms of the mould. The mould is then left till the cast has become sufficiently dry; it may then be taken out without the danger of breaking.

The time for withdrawing the cast from the mould is easily known by its shrinking; but first it is necessary to take off all the composition that exceeds the height of the mould, with a knife; so that it may present a plain and smooth surface; the substance not being entirely dry is more easily cut than afterwards. These ornaments are afterwards glued on the furniture for which they are intended; and if designed to be of the same colour as the wood, a little spirit varnish should be used. Considerable attention is necessary, and the operator should be well acquainted with the process, to know when they are properly moulded. These ornaments are generally gilt, and remain very solid. Cabinet-makers could make tasteful and appropriate ornaments by using paste composed of different woods, than they now do, and with much greater ease, than by carving. [*London Journal.*

NEW MODE OF MANUFACTURING GLASS.

M. Legnay has invented a new method of manufacturing glass, without the use of alkali. He has obtained a *Brevet d'invention,* in France, and the following is the process:—Take 100 parts of dried sulphate of soda, 656 parts of silica, and 340 parts of lime, which has been exposed to the air. All these materials must be mixed with the greatest exactness. The furnace and the pots must be heated till they are of a reddish white colour, when the mixture should be put, in little balls, into the pot until it is filled. The mouth of the pot should then be stopped up, and with its contents introduced into the furnace; and as soon as it is perceived that the material has sunk in the pot, more of the same mixture must be put in, until the pot is filled with a melted vitrous substance. A strong fire must be continued, in order to obtain a complete fusion in as little time as possible. When the fumes diminish, small

portions must be taken out at different times, to ascertain whether the glass be sufficiently refined, which generally becomes so in about twenty-two hours. This glass is then fit for use: it may, without risk, remain double the time in the furnace.

Another mode proposed:—To take 100 parts of muriate of soda, well dried, 123 parts of silica, 92 parts of lime which has been exposed to the air, well mixed together, and fused in the same way as above described: in sixteen hours a good glass will be obtained, which will be fit for use, for any purpose that may be required.

[*Description des Brevets d'Invention*, vol. viii.

ENTERPRISE STEAM VESSEL.

By an extract from a letter, dated Cape Town, Oct. 14, we learn the above vessel has reached the Cape in safety; the commander, considering, though the voyage has been rather long, that he has fully established the practicability of a steam-vessel weathering the open ocean under all circumstances.

The experience that has been gained, will, in future, obviate many of the difficulties and disadvantages that have been sustained during this voyage of experiment. In the first place, the engines were not large enough for the tonnage of the vessel; for in the calmest weather, they were never able to make more than eight knots per hour.

Another mistake seems to have been the little regard paid to the sailing department; and certainly not the least, the inefficiency of the crew. It seems they met with extraordinary heavy seas, and head-winds; difficulties that might have been surmounted, but for the want of fuel, which ran short; thereby, causing them to steer in an indirect course, and losing ten days. The commander is very sanguine in favour of the undertaking, and feels convinced of the certainty of performing such voyages in safety.

The slavery to the crew, of shipping coals, will be removed, as it is intended to establish depots, and so only fill the coal boxes forward, which will suffice for fifteen days consumption: by this plan, the vessel will be enabled to stow a considerable quantity of cargo. Great praise is bestowed upon the excellence of the machinery; for in steaming for ten days together, there was only occasion for ten minutes stoppage, to oil its various parts. The vessel being forced to deviate from its course, put into St. Thomas's for water, and received the greatest civility from the Governor, who is a Portuguese General. [*London Journal.*

NEW PATENTS IN ENGLAND, SEALED, 1825.

To Augustus Count de la Garde, of St. James'-square, Pall Mall, in the county of Middlesex, in consequence of a communication made to him by a certain foreigner residing abroad, for a certain improved machinery for breaking

or preparing hemp, flax, and other fibrous materials—Sealed 24th November—6 months for enrolment.

To Joseph Eve, late of Augusta, Georgia, in the United States of America, but now residing at Liverpool, in the county of Lancaster, engineer, for his invention of an improved steam engine—24th November—6 months.

To Henry King, of Norfolk-street, Commercial-road, in the county of Middlesex, master mariner, and William Kingston, of our Dock Yard, Portsmouth, master millwright, for their invention and discovery of certain improved fids for top-masts, bowsprits, and all other masts and spars to which the use of the fid is applied—26th November—6 months.

To Richard Jones Tomlinson, of the city of Bristol, gentleman, for his invention of an improved frame-work for bedsteads and other purposes—26th November—6 months.

To Marc Lariviere, of Prince-square, Kennington, in the county of Surrey, machinist, for his invention of a certain apparatus or machinery to be applied to the well known stamps, fly presses, or other presses for the purposes of perforating metal plates, and for the application of such perforated metal plates to various useful purposes—28th November—6 months.

To William Pope, of Ball Alley, Lombard-street, in the city of London, mathematician, for his having invented certain improvements on wheeled carriages—3d December—6 months.

To William Pope, of Ball Alley, Lombard-street, in the city of London, mathematician, for his having invented certain improvements in making, mixing, compounding, improving, or altering the article of soap—3d December—6 months.

To Henry Berry, of Abchurch-lane, in the city of London, merchant, for his new invented improved method, in different shapes or forms, of securing volatile or other fluids, and concrete, or other substances, in various descriptions of bottles and vessels—3d December—6 months.

To Ezekiel Edmonds, of Bradford, in the county of Wilts, clothier, for his invention of certain improvements on machines for scribbling and carding sheep's wool, cotton, or any fibrous articles requiring such process—3d December—6 months.

To John Beever, of Manchester, in the county of Lancaster, gentleman, for his having invented an improved gun-barrel—3d December—6 months.

To Edmund Lascombe, of East Stonehouse, in the county of Devon, merchant, in consequence of communications made to him by a certain foreigner residing abroad, and discoveries made by himself, for a method of manufacturing or preparing an oil or oils extracted from certain vegetable substances, and the application thereof to gas light and other purposes—6th December—6 months.

To John Phillips Beavan, of Clifford-street, in the county of Middlesex, gentleman, in consequence of communications made to him by a certain foreigner residing abroad, for an invention of a cement for building and other purposes—7th December—6 months.

To Francis Halliday, of Ham, in the county of Surrey, Esquire, for his invention of certain improvements in machinery to be acted upon by steam—9th December—6 months.

To Joseph Chesseborough Dyer, of Manchester, in the county of Lancaster, patent card manufacturer, for his invention of certain improvements in machinery for making wire cards for carding woolen, cotton, tow, and other fibrous substances of the like nature, and also certain improvements on a machine for shaving and preparing leather used in making such cards—9th December—6 months.

To Robert Addams, of Theresa Terrace, Hammersmith, in the county of Middlesex, gentleman, for his new invented method of propelling or moving carriages of various descriptions on turnpike, rail, or other roads—14th December—6 months.

To Matthew Ferris, of Longford, in the county of Middlesex, calico printer,

for his new invented improvements on presses, or machinery for printing cotton, and other fabrics—14th December—6 months.

To James Ashwell Tabor, of Jewin-street, Cripplegate, in the city of London, gentleman, for his having invented, or found out, means for indicating the depth of water, in ships and vessels—14th December—2 months.

Proposals for publishing by subscription, under the auspices of the Pennsylvania Society for the Promotion of Internal Improvement, and the superintendence of the author, The Reports of William Strickland, *Esq. Engineer, agent for the above Society, on a tour through Great Britain.*

I. Upon Canals. This report embraces the method of forming canals on precarious and infirm foundations, with the most approved plans of building *lock walls, gates, valves, sluices,* and *aqueducts.*

II. On Canal Boats. Plans, elevations, and sections of canal boats, with and without striking masts.

III. On the *breakwater and artificial harbour* now constructing at the entrance into the Bay of Dublin, containing plans, sections, and elevations.

IV. On cranes and hoisting machines. Drawings and descriptions of the cranes used for loading, and unloading canal and other boats, and for *hoisting* and *setting stone* in the building of locks, &c.

V. On Tunnelling; including a full and accurate account of the Harecastle, and Thames and Medway tunnels, accompanied by plans, and sections, of the *working and air shafts, horse gins, centring,* and other machinery used in the construction of these great works.

VI. On railways and locomotive engines, containing *details* of the several forms of rails, and the method of fixing them upon their foundations. The construction and use of the *brake* upon inclined planes. The formation of *wagons, sidelings,* and *passing places,* together with the most approved plans of crossing public roads.

VII. On turnpike roads.

VIII. On the manufacture of iron, and of oil and coal gas.

IX. On coking bituminous coal, and on making cast and blister steel, with plans and sections of the furnaces, and descriptions of the instruments used in the conversion of iron into those valuable articles.

X. On rollers of copper. A drawing and description of the method used in manufacturing copper rollers for the printing of calico.

On the advantages of disseminating the valuable information these reports contain, the Society decline expatiating. They confine themselves to the simple statement, that they have met with the decided approbation of every intelligent person who has examined them. The Society are sincerely desirous that the benefits they are so well calculated to produce, should be generally diffused—and the present prospectus is circulated, in order to ascertain how far the public spirit of our citizens, and of our public institutions, will warrant the undertaking.

The work will contain about eighty large engravings—some of them from two to three feet long. It will be in folio, half-bound, in the atlas form, and will be put to press as soon as two hundred and fifty copies are subscribed for. The price will be ten dollars per copy.

Payment to be made on delivery of the work.

Subscribers names, received before the time of publication, will be inserted.

Lists of subscribers to be forwarded to G. Ralston, Secretary.

THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE.

DEVOTED TO THE MECHANIC ARTS, INTERNAL IMPROVEMENTS AND GENERAL SCIENCE.

MARCH, 1826.

FOR THE FRANKLIN JOURNAL.

On the Rise and Progress of the Franklin Institute.

CONCLUDED.

Upon some of the points brought before the attention of the meeting, the discussion was long, and ably carried on. Much interest in the subject was evinced, and however warmly each advocated his opinions, yet the unanimity with which all concurred in the decisions of the majority, showed evidently, that the wishes of all were directed to the achievement of the same great object; and that the anxiety of each was, not so much for the triumph of his own opinions, as for the adoption of those measures which would best ensure the success, and duration of the Institution.

This meeting has been considered as fixing the period of the organization of the society. Previous to that day, the committee had, with a view of enlisting additional support to their plan, opened a book, in which many of their friends had been induced to inscribe their names; at the beginning of the meeting, it did not include more than one hundred signatures, but a considerable number was soon added to the list.

The first election for officers, was held at the time appointed; and terminated in the choice of a Board, composed principally, of men practically engaged in the mechanic and manufacturing arts; and who have hitherto shown themselves fully aware of the important interests confided to them. We have observed, that in several of the European Institutions, the choice of managers is in part, or wholly restricted to the class of journeymen mechanics; an idea having been unfortu-

nately held out, that their interests, were distinct from those of the master mechanics; and that the latter could not be entrusted in the management of an institution, one of the principal objects of which, is to educate their own sons and apprentices. Fortunately no such principle of exclusion pervades our association; and we deem the absence of it, to be by no means unconnected with the prosperity which has hitherto attended it. We trust that all mechanics' institutions will succeed, in spite of any obstacle which may be thrown in their way; but we cannot close our eyes to the fact, that all have not achieved objects, commensurate with the hopes of their founders. We know of one, established in a city much larger than Philadelphia, the success of which has not exceeded, scarcely equalled ours, though it has met with large donations from many of its public-spirited members. In the instance to which we allude, we have reason to believe, that the failure was produced by that provision of the constitution, which required the introduction of a large proportion of journeymen, into the Board.

Since the foundation of the Franklin Institute, no event has occurred to interrupt its successful progress. Its usefulness, in more respects than one, has been felt and acknowledged. Comprehensive in its views, it includes within its design, every measure that can promote the success of those, to whose interests it is pledged. Unrestricted, as to the qualifications of its members, it enlists with pleasure, among its supporters, all persons disposed to countenance, and foster our manufactures. It touches not those points upon which differences of opinion, have been, and are still entertained, by our public-spirited, and enlightened statesmen. The Franklin Institute interferes not in the great question of protecting duties; it has no political object in view; the framers of its constitution, were deeply sensible that its great object, the promotion of the mechanic arts, would be best secured by restricting the views of the society, to the dissemination of knowledge; to the enlightening the mind of the youthful apprentice, to the examination of the inventions made by the mechanics of our country, so as to test their novelty, or the soundness of the principles upon which they were constructed, and finally, to the proud display of our manufactures at stated periods; in order to convince the incredulous, of the progress which our artists are making, and with a view that the unprejudiced citizen, may compare our own productions, with those which he is in the habit of importing. Satisfied, that whenever he is enabled to obtain the former, of equal quality, and at the same price as the latter, his own interest will induce him to encourage his manufacturing fellow citizens, to the exclusion of foreign artists. The reports made by the Board, to the Institute, at their quarterly meetings, contain so full a history of the transactions of the Society, and have been so widely circulated, that we feel ourselves excused from dwelling long upon this subject. We shall, however, briefly state the most prominent objects achieved by it; and some of those, which still remain to be prosecuted, as the Institution shall become more generally supported, and more wealthy.

The course of instruction in the Institution, was commenced on the 28th of April, 1824, by a lecture delivered at the Philadelphia Academy, in North Fourth street. The Institute being at that time unprovided with a building, and its funds being very low, an application for the use of the rooms in the Academy during the summer, was made to the Trustees of the University of Pennsylvania; it is unnecessary to add, that the request was very handsomely, and liberally granted. The lectures, which were on miscellaneous subjects, and were delivered gratuitously, by volunteer lecturers, were continued weekly, for several months. The size of the class, gave sufficient assurance, that the mechanics of the city, were fully aware of the importance of the rising institution. The number was found to be considerably increased, at the commencement of the winter, when lectures on Chymistry as applied to the Arts, Natural Philosophy and Architecture, were regularly delivered by Professors appointed for this purpose; and to whom small salaries, proportioned to the funds of the society, were voted. In addition to these, the system of volunteer lectures, which had given such general satisfaction during the summer, was continued once a week. The lectures were kept up until the month of April.

About the middle of November last, a third course of instruction was commenced, which included, besides the regular lectures of the preceding winter, a course of Practical Mechanics, and one of Natural History. To the latter, the members were allowed to introduce ladies; it had been believed that few would avail themselves of the privilege, and it was therefore with surprise, as well as pleasure, that the Board found the class included nearly one hundred ladies.

Aware that the Institution was intended, more especially, for the education of youthful, than of adult mechanics, the attention of the members was directed, at an early period, to the adoption of measures which would secure this object, and at the same time not interfere with the order and quiet of the class. This was at last accomplished, by issuing, to each member, any number of tickets that he might require for his sons and apprentices; he paying, for each of these tickets, the sum of one dollar. This amount, so small in itself, that it can in no manner produce inconvenience to those who pay it, is, however, sufficient to prevent any from attending, whose only object would be the gratification of an idle curiosity; while, at the same time, it insures the punctual attendance of those whose friends have incurred this expense. Of the success of this plan, no statement can give a more satisfactory idea, than the fact, that the number of junior students, who attended the first course of lectures, amounted to 27—that to the second course, 126—and that to the third course, 180.

The method of teaching by lectures, excellent as it is in subjects which require experiments and demonstrations, cannot, however, be extended to all branches of instruction. There are some which can be taught only in schools, where the instructer converses freely with his pupils; solves their doubts, removes the difficulties which they may suggest, and never proceeds to a new subject until the former is fully understood. Of this nature is the science of ma-

thematics; and, for obvious reasons, the art of drawing, can only be taught in this manner. These being deemed all important to the mechanic, schools were opened for instruction in drawing and mathematics, in the winter of 1824–5. These could not, of course, be made accessible to all, upon the same terms as the lectures; but the tickets were placed at so low a rate, that the price of them could scarcely be an objection. These schools have flourished: the number of scholars, at present in the drawing school, is about forty; in the mathematical school, about twenty.

The advantages of this method of instruction have been so fully acknowledged, that we have heard it stated, as the opinion of several members, that it might be judicious to extend it, so as to include all the branches of an elementary education; particularly reading, writing, and arithmetic. There are in the city, and among the members of the Institute, many persons whose circumstances in life, are such as not to make it necessary for them to depend on public schools for the instruction of their children; but, to whom, the prices paid at most private schools, would be inconveniently high. There are also many who could not spare the services of their children, at those hours of the day, at which the schools are generally held: for these, the establishment of evening schools, at a moderate price, and under the superintendance of an able teacher, would doubtless prove a desirable object. This plan, might perhaps be extended, with advantage, still further, so as to make it include some of the higher branches of mathematics. There may be difficulties in the way, which will retard, or even prevent the adoption of this scheme; but we believe it practicable, and hope it will be brought forward. Indeed, we almost feel confident of its success, as we know that it has long been a subject of deep consideration with some of the most active and zealous members of the Institution, whose suggestions have hitherto generally proved successful.

Next in importance, to the extension of education, is, undoubtedly, the exciting of a spirit of proper competition among the manufacturers, by means of premiums, and annual exhibitions. Accordingly, this also received the attention of the Institute from the earliest moment of its existence; and the two first exhibitions, which were held in October, 1824 and 1825, have, it is believed, given general satisfaction, and been productive of much good. Gold, silver, and bronzed medals, had been offered for the best articles presented in many branches of industry, and upwards of fifty silver, and bronzed medals, have been awarded. It is to be regretted, that the limited funds of the Society, and the great drafts made upon it for various important objects, have restricted it in the number and the value of the premiums offered and awarded. There cannot, we believe, be a more agreeable, or a more useful application of money, than the rewarding of merit and skill in the arts. It may be a question, not unworthy of the attention of the legislator, to consider what part of the progress made by the arts in England, is to be ascribed to the liberal rewards so judiciously bestowed by the public spirited Society for the encouragement of the Arts, in London. The slight annual expenditure, which would be

incurred in this manner by our state, would be amply repaid to the nation, by the additional sources of wealth which it would receive from the resulting improvement in the arts.

As accessory, but not less useful branches of the Institution, are the creation of a library, and of a collection of minerals. These are yet in their infancy, but in the course of time they must necessarily become valuable. The day will likewise come, we trust, when the Institution will be able to establish, and keep open, a laboratory expressly devoted to the gratuitous chymical examination of all minerals that may be sent to it, from any part of the state. This could be easily accomplished, and at no very great expense, in a well conducted laboratory, placed under the care of a skilful professor, whose duty and interest it would be made, to devote his whole time to it. Under proper regulations, students might be admitted, in order to become practically conversant with the principles of chymistry, especially in its relations to the arts; and series of experiments might be occasionally instituted, to test the value of projected improvements, or of new processes. A workshop, established with similar views, but placed under the control of a skilful mechanic, might offer opportunities to young men to become familiar with the use of tools. They might be taught the art of turning, and probably some of the different branches of clock-making, which offer such beautiful illustrations of the principles of mechanics.

Perhaps, one of the most interesting steps which the Institute has taken, has been the erection of the new Hall; a spacious and elegant edifice, which, if we may trust to calculations that have been carefully made, promises to become a productive property to the Institution.

Finally, the publication, under the auspices of the Institute, of a Journal devoted to the promotion of the mechanic arts, is another of the means which the Society has devised for the attainment of the objects for which it was instituted.

On reviewing what has been done by the Franklin Institute, no doubt will, we trust, be entertained, that it has accomplished much, and realized the fondest hopes of its projectors. That there still remains much to be done, cannot, however, be doubted; and it appears to us equally certain, that as the Society increases in numbers and in wealth, a wider field will open before it; and new objects, at this time little thought of, will present themselves to its attention, thereby affording to it the means of extending its usefulness, and of applying the surplus of its funds. The number of its members, is computed, at this time, at upwards of one thousand; and great as this may seem, we feel convinced that it is not one-third of what it will eventually become, if no unforeseen event occurs to mar its prospects. There is no reason that need prevent a person from joining the Society, but extreme poverty; and how few are there in our city, so restricted in their pecuniary concerns, as to be unable, annually, to devote the sum of three dollars, to the promotion of the public good; especially when this small appropriation will afford to their children the means of instruction; rendered the more acceptable, and the

more valuable, by its being paid for. On the other hand, there is not a person in the city, placed by his wealth, or by his relations in life, in circumstances that make him wholly independent of, or uninterested in, the progress of the arts—as a citizen, he is imperatively called upon to promote the public good, and as one gifted by Providence with wealth and plenty, it becomes especially incumbent upon him to contribute his mite to the extension of education, and to the encouragement of the labouring and industrious portions of the community. W.

In our last number we published the Prospectus of the Reports of Mr. Strickland, made in conformity with the Instructions of the Society for the Promotion of Internal Improvements: we now conclude these instructions, which, together with the extracts from the first annual Report of the Acting Committee formerly given, will furnish a tolerably correct idea of the value of the proposed work.

Society for the promotion of Internal Improvements.

MR. STRICKLAND'S INSTRUCTIONS.

[CONCLUDED.]

Turnpikes.—On the subject of the improved mode of constructing roads by Mr. M'Adam, we have, as you know, all that has been published. These publications, however, give us rather the evidence of the excellence of the roads made upon that plan, than a practical and familiar description of the *manner* in which they are executed. A report descriptive of the first preparation and arrangement of the ground over which the road is to pass, and which is to become the foundation of the stone-work; the following steps preparatory to the covering of this, with stone; the nature of the stone to be used; its preparation, and the manner in which it is applied; the measures adopted to prevent injury to the road while in the course of construction; the final completion of the road, and the mode of keeping it in order; with the regulations as to its use, particularly the description of carriages or wagons used upon it: all these will command, and obtain your careful attention. Should you think the suggestion worthy of your consideration and adoption, we would propose that you should prepare, or obtain a memoir on this subject, directory of the course of proceeding to construct a M'Adam's road; so particular, so full, so descriptive, so plain, and accompanied with such illustrations by drawings, as will enable any good road maker, to commence and execute the work.

A person who is perfectly acquainted with M'Adam's principles of road making, who has been accustomed to apply them in the construction of roads, and who should bring with him testimonials of character and practical skill, would find employment in the United States. The Society will not give a pledge to compensate such an individual for visiting the United States, but you are authorized to assure him, that all that the patronage and efforts of the individual members of the association can do, to promote the fortunes of such a man, will be exerted.

Gas Lights. The proposed introduction of gas into the city of Philadelphia, makes it important, that at as early a moment as your other duties will permit, you furnish a full report upon this subject. What is the best and most economical apparatus? What material is preferred, and the reasons for the preference, the cost of the material in England, the most approved plan for conducting gas from the place of manufacture to where it is used, the employment of detached and transportable gasometers or fountains, and their cost, and their mode of use, and how all the machinery which may be required for the construction of the works, and for the distribution of gas in Philadelphia, can be obtained, and at what costs? These are submitted as heads of inquiry.

Break Waters. The intimate connexion between the commercial prosperity of our state, and its internal improvement; and the important advantages which would be consequent on the erection of a breakwater, at the mouth of the bay of Delaware, have induced the Society to ask you to procure information of the most approved plan for constructing a floating breakwater. A floating breakwater is said to have withstood the destructive storm which lately shook, to its foundations, that which was built of stone at Plymouth; and as the cost of the former is said to be much less than that of the latter, it is desired to obtain a full knowledge of the plan, and construction of the same; how anchored and sunk, its capacity to resist the ocean, and the effect of the same upon it; its cost and its competency, compared with works of a similar kind, which are built of stone, and are intended to be immoveable?

Manufacture of Iron. We approach this subject with the deepest impression of its importance, and with a firm conviction that the full investigation of it, will require more time than you can bestow upon it. We are satisfied that it would yield golden returns, if an agent of competent talents and information, should be exclusively employed in the investigations and inquiries, connected with the manufacture of iron, in England and Wales. If the wealth of England has been correctly ascribed to her iron, and her coal, Pennsylvania may with equal certainty, become the England of the New World, in these riches; for she has coal of a quality superior to that of her most prosperous rival, and she has great varieties of this most valuable mineral; and she has iron ores of every description and kind which are known in any part of the world. No improvements have been made here in it, within the last thirty years; and the use of bituminous and anthracite coal, in our furnaces, is absolutely, and entirely unknown. It is said, that since the use of mineral coal in the making of iron, was introduced, England has increased the manufacture of this article, many thousand fold; and the cost of its production, has been diminished one-half.

Attempts, and of the most costly kind, have been made to use the coal of the western part of our state, in the production of iron. Furnaces have been constructed according to the plan *said* to be adopted in Wales, and elsewhere; persons claiming experience in the business,

have been employed, but all has been unsuccessful. In large sections of our state, ore of the finest quality, coal in the utmost abundance, lime-stone of the best kind, lie in immediate contiguity; and water power is within the shortest distance of these mines of future wealth. The prices which are obtained for iron on the western waters, are double those of England; the demand is always greater than the supply, and thus, nothing but knowledge of the art of using these rich possessions, is wanted.

But it is not only in the knowledge of the production of iron, that we are behind the country you are about to visit. In the art of casting, in making bar-iron, the improved state of knowledge you will find in England, has given her a superiority, which would enable her to command our own market, but for the protection the manufactures have in the tariff.

We desire your attention to the following inquiries on the subject of the manufacture of iron.

1st. What is the most approved and frequent process for coking coal, and what is the expense of the process per ton, or chaldron?

2d. In what manner are the arrangements or buildings, if any, constructed for the coking of coal? obtaining drawings, and profiles thereof.

3d. Are there different modes of coking coal? and if they have any differences in principle, what are they?

4th. In what manner are the most approved furnaces for the smelting of ore, constructed? Drawings and sections of the same to accompany the information which may be obtained upon this inquiry.

5th. The mode of drawing off the pigs, and the plan adopted for keeping a supply of ores; if peculiar, or superior to that used in this country.

6th. The making of castings. Is there any process by which castings are made *soft*, so that they may be substituted for brass or copper? if there is, what is that process?

7th. What is the most approved construction of a foundry, and what the most approved mode of casting? Drawings, profiles, and minute descriptions to accompany the information you may collect, upon these inquiries.

8th. What is the most approved mode of making bar iron, and what is the most approved machinery used in the same? drawings, profiles, and a description of the same are requested.

9th. Is the *Anthracite coal*, used in any processes for making or using iron? If it is, all the information of the mode of its use will be of the greatest importance.

10th. The best mode of making steel. Where is it made, from what quality of iron? How the English blister is prepared, the process for its production; does it require a peculiar kind of iron, or does the quality of the best steel, depend exclusively, on the mode of carbonating the iron?

11th. At what stage of the process of converting bar iron, into

steel, does the agency of the coke commence? Is charcoal used in any of the processes for making steel? When, how, and to what extent is it used, if at all?

12th. What is the construction of a furnace for making steel, upon the best, and most approved principles? What time is required to convert a given quantity of iron, into steel? The degree of heat, the material from which the iron absorbs the carbon, how prepared?

13th. What proportion of the English bar iron, is made at present by *rolling*, and what by *hammering?* What is the opinion of enlightened practical men, as to the comparative merits of each?

14th. Has the English iron been so far improved, as to admit of its being used in the manufacture of cast steel in competition with the Swedish? If so, from what ore is it obtained, and by what process? Is the coke of bituminous coal, used in this process?

We submit for your prudent consideration, some suggestions on the subject of these inquiries, assuming the fact that they cannot be prosecuted by you, to the full extent. We are willing, on the part of the Society, to authorize you to expend, in obtaining all the information which they seek for, the sum of one hundred pounds sterling. This sum might induce some individual to prosecute in detail, the investigations, and collect the information so much desired. This will not be an unprofitable expenditure by the Society. But one gentleman, interested in the manufacture of iron, is a member of the Society, and we shall take care to reimburse the Society from among those who manufacture this great staple of the state, before we communicate what you shall transmit to us.

You are aware of the importance which is here attached to the use of *anthracite* coal, in the smelting of iron. To the eastern portion of our state, full and accurate knowledge of this art, if it exists in Ireland or England, would be productive of the richest results. Should you find that anthracite coal is in use in making iron from the ore, and any one, with perfect skill in the art, and of good character, will come to this country for the purpose of obtaining employment in the making of iron with the anthracite coal; you may agree that his passage to Philadelphia shall be paid by the Society, and you may give him every assurance of further patronage.

Rollers of Cast Iron.—How are they cast and hardened?

Rollers of Brass or Copper for Calico Printing.—There is a patent for making these. Endeavour to get at it, and acquire all the information which will enable one skilled in the art, to cast them here. This is to be the subject of a special report, accompanied with a model, if you can procure one.

Machinery.—Useful machines of all kinds will command your attention. Those which can be employed in connexion with canals, and roads, will be of the highest importance. The letter of Professor Keating, suggests inquiries on the subject of steam boats, used for canals. These may become very important here, and steam boats with small draughts of water, will be required for some of our rivers, if they shall be made navigable by dams.

The letter of Thomas Butler, Esq. suggests for inquiry, the mode

for diffusing heat in vessels. That of Mr. Sellers, to the best machine for preparing, and dressing flax. We beg your attention to these subjects. As you have the aid of Mr. Kneass, your pupil, we have less hesitation in claiming from you frequent communications, of your progress, and success. These, if favourable to the purposes of your agency, will give confidence to the members of the Society ; and they will also justify our claims on the citizens of Pennsylvania, to aid us, by pecuniary contributions. You may rely on the exercise of a careful, and guarded discretion, in making public, by means of the press, the contents of your correspondence. To the members of the Society, your commmunications will always be open ; but their publication in any other form, will be the result of proper deliberation.

During your absence, we shall have frequent occasions to communicate with you. We shall forward all our letters to Messrs. Curwen and Hagerty of Liverpool, and we would suggest that you, at all times, place with them your address, and through them, by our Philadelphia packets, communicate with us, directed to the Corresponding Secretary.

By the resolution of the Society, passed on the 3d of February last, you were appointed the Agent of the Society, to proceed to Europe, for the purpose of prosecuting the inquiries, stated in your instructions. Your compensation for an absence of twelve months, on the duties assigned to you, is to be $2500, of which £400 sterling shall be placed to your credit in England, at par, and the residue of this sum, to be paid to you, or your order here.

In your instructions, you are authorized to expend one hundred pounds sterling, for obtaining correct information relative to smelting iron ore, and the improved manufactory of iron.

The Society, by a resolution adopted at the meeting held on the 17th March, instant, have authorized you to expend one hundred pounds sterling, for memoirs, publications, models, drawings of useful machines, and authentic information on all subjects which are important in this country.

You will take due notice of these appropriations, and we beg leave to recommend a judicious economy in the expenditure of this money, and that you keep an accurate account of the same, which you will render to the Treasurer of the Society.

The arrangements in relation to the funds to be placed at your disposal in England, and the payments to be made here, are left with the Treasurer, Mr. White, who will attend to the same.

We desire an acknowledgment of the receipt of these instructions, and your assent to the same. With every wish for your success in the performance of the important duties assigned to you, and of a happy and safe return to your family and friends, we are, with great esteem and respect,

Your obedient servants,

MATHEW CAREY,
RICHARD PETERS, Jun.
JOSEPH HEMPHILL,
STEPHEN DUNCAN,
} *Members of the Acting Committee.*

Attest, GERARD RALSTON, *Corresponding Secretary.*

New Metal, in imitation of Gold; called Mosaic Gold.

A new discovery has recently been made by Messrs. Parker and Hamilton, in mixing a certain alloy of metals, which exactly resembles fine gold. The base of the metal is supposed to be copper, and a constituent part of the alloy, zinc; but the composition, and its proportions, are for the present, kept secret. Messrs. P. & H. have obtained a patent for their discovery, but the specification will not be enrolled until next May. The colour of the metal is extremely beautiful, and uniform throughout the mass; its specific gravity is considerably less than gold, but something more than copper; the cost price of it about the same as brass, and it is susceptible of being cast, chased, carved, and burnished.

The specimens we have seen, were wrought into fruit, foliage, and scroll work, which exactly resembled fine gold, with a matted, and burnished surface. It is said that this metal will not be subject to oxydation in the open air, and that it has resisted some of the acids; may be easily re-polished, but will not retain its character if re-melted, without being treated in a peculiar manner. These are all the particulars we have yet been able to collect, but as the subject is likely to become of considerable importance, and to engross much of the public attention, we subjoin the account given by the patentees themselves.

"In introducing the above invention to public notice, and in developing those views of it, which almost naturally arise, it is but due to the patentees to state, that the discovery of "The Mosaic Gold" was not the result of accident, nor a fortuitous combination; but is the reward of a series of costly, and laborious experiments, carried on at intervals, for upwards of twenty years, and more particularly for the last three years; during which period, the most active and unremitting perseverance has been used, to obtain the metal in the state of perfection which the specimens exhibit.

"The richness of colour, and close resemblance to gold possessed by this new metal, induced an individual, well qualified to appreciate its merits, to submit it to his Majesty, who, ever ready to promote the interests of science and the arts, has graciously condescended to permit the patentees, to announce to the world that he patronises the invention. This gratifying encouragement, together with the boundless field of trade, opened by the applicability of the Mosaic Gold to all purposes of the useful and decorative arts, at once convinced the patentees, that their individual power would be utterly inadequate to establish and support the extensive manufactories, necessary to carry into execution the various lucrative objects that presented themselves. These considerations, and the great importance of the trade, (even in a national point of view,) which must result from the manufacture of an article possessing the qualities of the Mosaic Gold, have determined the patentees to grant licenses for working it; as the best means of extending the interests, and diffusing the great benefits arising from the introduction of an article, which, as must be obvious to every one, admits, and will reasonably bear, considerably more than the ordinary

profits of trade. This position will be best supported by the following statement of the *qualities*, *uses*, and *advantages* of the Mosaic Gold:

"1. The Mosaic Gold possesses throughout its whole mass, a rich golden colour, far superior to the colour of pure gold, and fully equal to that of its most beautiful alloys.

"2. It is capable of being cast, and worked into any form, with the same facility as other metals.

"3. While the Mosaic Gold is so beautiful, when highly wrought and applied to articles of superior value, as to challenge a rivalry, in its appearance with gold itself, it can also be produced in other states, which, as respects price, will admit of its being used for architectural and other embellishments.

"4. Being of a uniform colour throughout its whole substance, it is peculiarly applicable to articles subject to wear, and friction.

"5. The Mosaic Gold, when applied to interior decorations, and furniture, does not produce the unpleasant odour of bronze, or brass.

"6. In case of accident, its original colour, and lustre, can be easily recovered, by the ordinary modes of cleaning gold, or silver.

"7. In addition to the above properties, the Mosaic Gold adds the invaluable one of not easily tarnishing or oxidizing, so that it may by simple means, always be preserved in its original freshness, and lustre.

"On this point a most decisive experiment has been made, by exposing several subjects, cast in Mosaic Gold, on the damp grass, for eight weeks, to the sea air, without any perceptible change or deterioration being produced in the colour; a fact which can be fully authenticated, and the particulars of which, may be had of the patentees.

"The Mosaic Gold is peculiarly applicable to the following articles, each of which forms an extensive branch of trade.

"Articles of plate and jewellery—salvers—plateaus—branches—wine coolers, &c.—candelabra—chandeliers—lamps—chimney-pieces—clocks—balusters for staircases—railings—architectural decorations—freizes and capitals of columns—statues and groups—bas-reliefs—vases—medals—enrichments for domestic furniture of various kinds—carriage and harness furniture, &c. &c.

"A valuable feature in this discovery, and most important as respects the Fine Arts, is, that from the metal being in itself, comparatively with gold, of small intrinsic value, liberal encouragement may be afforded for the talents of our first artists, to make designs and models, from which articles in Mosaic Gold, of unparalleled beauty, may be manufactured; for all persons of taste, who have visited the continent, and inspected the extensive manufactories of works of art, in bronze, must lament how much we are excelled in this, perhaps the highest branch of manufacture; and it is therefore with pleasure the inventors can assure the public that extensive works, commenced under the most favourable auspices, are now erecting in the Regent's Park, which will afford every opportunity of attaining these desirable advantages.

"In order to place this invention on the most liberal plan, the Mosaic Gold will be sold to the trade in ingots, and licenses may be obtained for working it."—[*London Journal of Arts and Sciences.*

ON BREWING.

Sir—Being a constant reader of your valuable Magazine, I observed, as far back as May 14th, and at subsequent periods, inquiries have been made concerning Brewing, the comparative strength of malt and sugar. &c. I expected to have had some valuable information on the subject, long before this time, but little elucidation has yet been given: will you allow me to state a few practical remarks that I have made?

The first grand step towards bringing to perfection, brewing, wine-making, fermenting, and distilling, (as they are children of the same family), is to have a universal hydrometer, or floating ball, to take the strength and value of worts, extracts, and spirits. It should be divested of all arbitrary, and local phrases; described in one plain, simple, and universal language; we could then communicate the results of our practice to each other, and be understood. I know of none so simple and effective as specific gravity—it is the groundwork or father of all others, and a language known in all parts of the kingdom.

Impressed with this idea, about fifteen years ago, I made my first attempt at scientific brewing, by superintending that process for my own family. Our brewing is small, consisting of about six bushels, six or seven times in the year, without regard to season or weather. I use a thermometer to try the heats of water in mashing, and worts in fermenting. I have also got made in the country, a very simple hydrometer, consisting of a floating ball, and a few weights, with which I take the specific gravity of my worts and extract, and the strength of spirits; as I sometimes experiment on distilling, in a small way, and occasionally, manufacture a little family wine. I have formed tables of specific gravity, corresponding with pounds and ounces of density and dry extract, as used by Dring and Fage, Dicas, and others; with the quantity of spirits created by different degrees of attenuation; I have kept a journal of proceedings, and the results: and if a description of the instrument, or the construction of the tables, or any other part of the process I have used, would in any way tend to simplify or render more easy the practice of brewing, which at present is very imperfectly, and irregularly performed, I would most willingly, send any thing I am in possession of, to you for insertion.

As your Leominster Correspondent has expressed a wish for a practical report, I have here sent a rough outline, with the probable results, which will vary with the circumstances. As addition is the easiest rule in arithmetic, I have stated the process, in the proportion of one single bushel of malt, and the produce calculated to one gallon, in lieu of a barrel, as it is usually given.

To mash.—Put ten gallons of boiling water into a tub, furnished with the usual appendages for drawing off the wort; when the water is cooled down to 180°, put to it one bushel of good malt; the coarser it is ground the better, so that every corn is broken (cylinders that bruise the grain are better than mills that grind it into flour); stir up the water, and malt, well together, let it stand three

hours, then draw it off, and you will have six gallons, four having been absorbed by the malt.

Second mash.—Put on five gallons of water, at 183°, stir it up well, and let it stand on, two hours; let it then run, and you will have five gallons off.

Third mash.—With about three gallons of water, at 186°; stir it up as before; let it stand on, about an hour, and you will draw off about the same quantity as you put water on.

Fourth mash, for Small.—Six gallons of water at 190°; let it stand on, during the time the ale is boiling.

Boil the Ale.—Put the three first mashings, which are about fourteen gallons, on the furnace, with one pound of good hops; let it boil as fast as possible one hour, then strain it off, and you will have little more than ten gallons.

Boil the Small.—Put the fourth mashing, of six gallons, into the furnace, and return the hops strained from the ale; let it boil as fast as possible, one hour and a half, or until it is reduced to about four gallons.

Produce.—The first strain-off of the ale will be ten gallons; at the heat of 75°, will be of the specific gravity of 1.077. The increase of weight, or density as it is called, will be about 7lb. 14 oz. heavier than the water weighed before it was put over the malt, and will contain 20lb. of dry extract, equal to 2lb. per gallon. The small beer, will have the specific gravity of 1.020—about 8 oz. of dry extract per gallon, or 2lb. the whole. Thus you have extracted and obtained 22lb. of soluble matter from one bushel of malt. From 19lb. to 23lb. per bushel, is the usual quantity, and I much doubt if more than 16lb. or 18lb. is, on the average, got from a bushel of malt, where the process is conducted by the rule of thumb.

Fermentation.—The grand, and most important process, remains yet to be performed. I wish I could do justice to the description of it. As soon as you have strained off the ale, put it into shallow vessels, and get the first violent heat out of it, as soon as possible. Put three or four quarts into a very shallow vessel, and cool it down to 80°; put to it, about a quarter of a pint of good fresh yeast; then empty it into a deep narrow vessel, and it will ferment rapidly. In the mean time, the other is cooling, and when reduced down to 75° put them altogether in the working tub, which should be deep, and not too wide. In about nine or ten hours, it will be in a high state of fermentation, with a fine white curly head of yeast, like a cauliflower; let it continue in that state, until the bulbs that are formed in the yeast, begin to look thick, heavy, and dim; and true, or solid yeast, is beginning to be formed; that is the time to tun it, or put it into the cask, before the head has fallen, when it is in the highest and more vigorous state of fermentation. The length of time it will require to arrive at that state, is very difficult to describe; varying, according to circumstances, from 18 to 36 hours. When tunned, as it is called with us, that is, put into the cask—it must be quite full, and the bung put in the top, and it will throw out yeast, or cleanse itself, from the top cork-hole in the front of the cask, just below the head; and it must be filled

up every two or three hours, until it ceases to throw out any more yeast. Then cork up the cask, pull out the bung at top, fill it up tip full, and it will throw up more yeast, which must be skimmed off occasionally, as long as any is formed; then take a little beer out, just to sink it down, so that it does not touch the head of the cask; put the bung loosely in, and in a few days, or when it has ceased to ferment, and is reduced to the same temperature as the cellar, bung it down tight. In a month, or less after, you may tap it, and have a good and wholesome beverage, rich in flavour, pleasant, good tasted, and as fine as wine.

I remain, Sir, your old servant,

EXPERIMENTUM CRUCIS.

Stratford on Avon. [*London Mechanics' Magazine.*

On the processes of Tanning, Leather-Dressing, and Dying, &c.

(Continued from page 120.)

Lastly, when fully tanned, the hide is taken out to drain, and stretched upon a convex piece of wood, called a *horse*, on which it is thoroughly smoothed, and beaten, with a heavy steel pin; or sometimes passed between iron cylinders, to make it more solid, and at the same time, supple; after which it is taken to the *drying-house*, a covered building, with apertures for the free admission of air, where it remains till perfectly dry.

The common calves skins, require, for the whole process of conversion into leather in this way, from two to four months; the thick sole-leather hides, from fifteen to eighteen, or twenty months; and a boar's shield, can hardly be finished in less than two years. Leather gains in weight, and improves in quality, the longer it is suffered to remain in ooze, (within certain limits,) and as it is sold by weight, this is also sometimes an object to the tanner, though counterbalanced to a great degree, by the length of time that must elapse before his capital is returned.

The art is indebted to M. Seguin, a tanner of extensive business, in France, for the first accurate explanation of the rationale of the process of tanning. According to the ancient idea of this process, the effect of the infusion of astringent vegetables, was supposed to be little else than mechanical; and that it acted in *constringing*, or *condensing*, the fibres of the dead skin, as it corrugates the skin of the palate, when tasted; and hence rendered it nearly impervious to moisture, and unsusceptible of putrefaction. This explanation, however, did not accord with the actual increase of weight, which the skin acquires by tanning; and which amounts, on an average, to an increase of from one-third, to one-fourth of the weight of the skin, when dry. M. Seguin, reasoning from the circumstance, that skin, before tanning, is completely resolved, by water, into a liquid jelly, but is insoluble after tanning, was led to the simple experiment of adding a solution of skin, (or glue), to an infusion of oak-bark; and found an immediate precipitate of a thick, tough, extensible, dun-white matter, strongly

smelling of tan, and insoluble in water, at any heat; and which, when dry, becomes of a dark-brown colour, and brittle.

This precipitate, is an intimate combination of gelatin, with that part of the vegetable infusion which gives the tanning property, and being altogether a peculiar substance, is denominated *tannin*, or *tan*. This precipitate, therefore, hardly differs from tanned leather, in any thing but in wanting the fibrous organized texture, and what other principles the skin may have absorbed from the bark infusion, during the maceration of several months, which a sudden precipitation would not effect. Tanning, therefore, consists chiefly in a slow and most intimate combination of vegetable *tan* with the fibre of the skin, which continues till the latter is saturated through its whole thickness.

But oak-bark contains other soluble matter, which certainly also enters the texture of the skin, along with the tan, and most intimately combines with it; for skin, when it has undergone the previous preparation already mentioned, appears to be able to absorb, and when absorbed, to retain, a great variety of vegetable, and animal substances. The infusion of oak-bark, contains, besides tan, the gallic acid, and an extractive matter, all of which contribute to the process, and form a part of the tanned leather. That the gallic acid is absorbed, is proved by the instant blackness which the leather assumes, when merely rubbed with a solution of any salt of iron. The extract appears to be that which gives the leather its colour, and some degree of flexibility ; and from the excellent observations of Sir H. Davy, on the process of tanning,* it seems probable that the quantity of tan absorbed, is a good deal regulated by the quantity of extract present; being in general, (the time of immersion, and strength, of the tan-infusion, being nearly equal,) in *inverse* proportion to the quantity of extract, or of mucilage, present in the infusion. This is found, by comparing the actual weight acquired by leather, by quick tanning in infusions of different tanning materials, the composition of which, has been previously ascertained by chymical analysis. The difficulty in experiments of this kind, of obtaining tolerable accuracy, is, however, very great; much greater than in the analysis of metals or minerals, on account of the great want of characteristic marks of distinction between vegetable matters, when a little changed by chymical union with other bodies, and the readiness with which their characters are irrevocably lost, by the common action of reagents.

The strength of the tanning infusion, also, most materially affects the quality of the leather, and the weight which the skin gains during the process. As tan is more soluble than extract, a solution made hastily, and with a large portion of the material, will be nearly saturated with tan, and contains comparatively, but little extract; and on the other hand, the residue of the above infusion, macerated for a longer time in fresh water, will give a solution, in which there is but little tan, but a large quantity of extract. Now it would seem, that skin has the

* Jour. Royal Instit. and Phil. Trans. for 1803.

power of fixing a larger quantity of tan, than of any other material, particularly than of extract; so that if already nearly saturated with extract, it will, of course, absorb much less tan than before; and, therefore, the entire increase of weight, will be much less in this way, than with tan alone. The quality also of the leather, will, of course, be probably different when compounded of skin and tan, with very little other ingredients, than when it is a compound of skin and tan, with a larger proportion of extract; and, in particular, the former seems to be more brittle and less durable than the latter, as far as experiments have been hitherto made. The mere duration of the process, also, as regulated solely by the strength of the infusion, that is, when precisely the same infusion is used, but more or less diluted, may probably, considerably affect the quality of the leather; for when the process goes on very rapidly, it is possible that the outer part of the skin may be tanned strongly, before the inner part is penetrated with the liquor; and as tanning gives a closeness of texture, and difficult permeability to liquids, it may happen that this very circumstance, may prevent that uniformity of saturation with tan, which would seem desirable.

The precipitate, made by a solution of gelatin, dropped into an infusion of any tanning vegetable matter, appeared by Sir H. Davy's experiments, to be tolerably uniform in composition, whatever be the other constituents of the vegetable infusion. Thus, when galls were used, the precipitate contained about forty-six of tan, and fifty-four of gelatin; with catechu, it contained forty-one per cent. of tan; with oak-bark, forty-one per cent.; and with the Leicester willow, forty-three. But real skin, will never acquire such an increase of weight as the solution of gelatin; either because other substances enter into the composition of leather, or because the texture of the skin will not allow it to condense, and chymically unite with so much tan, as the same skin when dissolved in the form of glue; for glue is only a solution of the refuse parts of skin. Thus it was found, that a piece of skin completely tanned, by three weeks immersion in a strong infusion of galls, only gained weight, in the proportion of thirty-nine, to sixty-one, of skin; and this was even the greatest increase of weight observed, (being much more than that of common leather,) and in consequence, made a much harder, and more brittle leather.

With regard to the effect produced by the time of immersion, it was found, in different experiments, that skin, apparently well tanned in each case, absorbed much more tan by rapid, than by slow tanning: one hundred parts of leather, prepared in two weeks, containing seventy-three of skin, and twenty-seven of tan and other materials, absorbed from the oak-bark infusion; and the same quantity of leather, prepared in twelve weeks, (the infusion being proportionably weaker,) containing eighty-five of skin, and fifteen of tan, and other vegetable matter. A similar difference was found, when infusion of willow-bark was employed.

The supposed improvement in the process of tanning, proposed, and actually practised, by M. Seguin, may here be shortly mentioned. This ingenious artist, wishing to abridge the enormous time (and consequent expense,) employed in common tanning, and considering the

tan, as nearly the only active principle in this process, adopted the plan of using solutions of tan, instead of the mixture of bark and ooze, usually employed, and of several and known degrees of strength, in which the skin might be rapidly passed from the weakest to the strongest, by a more regulated gradation than is usually done. For this purpose, he had a series of vats containing the oak-bark, and began by pouring water on one of them, and after a short time drawing it off clear, through a hole at the bottom. This first ooze, was then poured on the bark of the second vat, and drawn off as before; by which it became sensibly stronger of tan. This liquor again was used to the third vat, and again to a fourth, according to the number, till it became quite saturated with tan. In the mean time, fresh water was poured on the bark of the different vats, in the same order, which produced a second ooze, still very strong, but inferior to the first: and thus three or four, or more, different oozes, were obtained, all differing in strength, and which was the tanning liquor employed. The skins then being previously prepared in the way already described, were passed successively through the different oozes, beginning with the weakest and ascending to the strongest, till they were completely tanned, which was known by the disappearance of the white line in the middle of the skin when cut through.

It appears beyond a doubt, that the process of tanning is most materially shortened, by this method of M. Seguin, and that very perfect leather is produced; but though known for several years, it does not appear to be adopted to any extent in this country, where leather is manufactured in vast quantities, both for home consumption, and for exportation to many parts of Europe, in which English leather is in the highest repute. From the way in which the oozes are made, according to M. Seguin, they must, of necessity, contain more tan, in proportion to the extract, and other vegetable matter, than where the bark itself is suffered to remain in substance, along with the ooze and the skin, for many months; as the tan is much the most soluble of all the substances that are to be extracted by water; so that bark may readily be exhausted of tan, long before the extract, resin, gallic-acid, and other materials are got out. It is said that the leather prepared in this new method, is less durable, and more brittle, than in the old way.

The only real improvement, of late, adopted in this part of the process, is, to use some of the oozes warm, by which the skin is sooner penetrated with the ooze, and a saving of time made, of some consequence.

Dr. Mackbride proposes lime-water to be used instead of common water, for the extraction of the tan, from the oak-bark; but this seems to be mischievous, as the only assignable effect of the lime, would be to contract a firm union with a portion of the gallic-acid, and the tan; the result of which would be, an insoluble calcareous substance, utterly unfit for any purposes of tanning.

[TO BE CONTINUED.]

ON IRON AND STEEL.—By THOMAS GILL, No. 3.

On hardening and tempering Springs at one operation.

This is peculiarly applicable to springs made of steel wire, or of sheet steel; and is found to render them considerably more elastic, and less liable to crack in hardening, than by the usual processes. It is effected in the following manner:—The springs are heated to the proper degree for hardening, in a crucible, placed in a proper furnace; and, instead of being quenched in oil or water, they are plunged into a metallic bath, kept over another furnace, at a heat a little below their tempering point, which is ascertained by means of a pyrometer immersed in the bath; and thus they are not cooled entirely, as in the ordinary methods (which renders them exceedingly liable to crack in hardening,) but only to *their proper tempering degree.* The metal for the bath may be plumber's solder, or any alloy of tin and lead, which is capable of fusing, at, or a little below, the proper temperature.—And the pyrometer may consist of a slip of brass, and one of steel, rivetted together, which are secured firmly at one end, to a metal plate forming the basis of the instrument; and, at the other, act on the shorter end of a lever or index, turning upon a pivot or centre, and whose longer end, marks the degrees of heat on a graduated arc, formed upon the surface of the metal plate. The whole should be enclosed in a case, to guard it from being clogged by coming into contact with the lead, and tin. The heat of the bath is lowered, from time to time, as required, by the addition of more of the metal, or by abating the heat of the furnace.*

Our readers will here see a great similarity, in principle, with Mr. Perkins's ingenious method of preventing his steel blocks from warping or cracking, in hardening; namely, by nearly cooling them down to their tempering heat, and not entirely cooling them, as is usual. It was, however, discovered and practised in this country, several years ago; long before Mr. Perkins made known his process, by Mr. James Stone, mechanist, of Warwick street, Golden square, who, in consequence of the great loss sustained by hardening and tempering his

* The pyrometer above-mentioned is an instrument intended to measure degrees of heat, higher than those which can be ascertained by the mercurial thermometer. The principle upon which its action depends, is the difference of expansion in metals of different kinds, by equal increments of temperature; when, therefore, the slips of brass and steel are rivetted together at the ordinary temperature, and are afterwards heated; the brass by its greater expansion, will cause a curvature in the rod, which will be proportioned to the degree of heat employed; the degree in which it is bent, and consequently its temperature, may be shown by means of an index, to which it, in bending, may give motion.

A little attention, we are convinced, will render the use of this instrument unnecessary, as the metallic alloy may be made fusible at the requisite temperature, and care must then be taken that it should be just hot enough to preserve its fluidity; this is readily known by its tendency to harden round the edges of the mass. In mechanical operations it is of great importance to simplify every process, as without this, the difficulties which present themselves, will prevent its general adoption.—Editor.

springs in the usual method, was forced, from necessity, to adopt a better; and was fortunate enough to discover the above; accidents now seldom happen in hardening and tempering his springs. It should, however, be mentioned, that he finally quenches them in oil, and blazes them off, as usual, in order to secure their toughness, and to coat them with a sort of oily varnish, to guard them from rust.

On restoring the elasticity of hardened and tempered Steel Articles.

Saws, sword-blades, clock and watch-springs, &c. which, after being hardened and tempered, require to be ground and polished, or otherwise brightened, lose their elasticity or springiness in those operations, so as to appear soft on bending them, although they are as hard as ever: these qualities are again restored to them, either by heating uniformly over a clear fire made of cinders, urged by bellows, or over the flame of burning alcohol, or by inclosing them in a smouldering fire made of wood-ashes and embers, to a blue colour: which colour may either remain, or be removed by the application of diluted muriatic acid, as before described in p. 80 of our last number.

On the partial conversion of Iron, into Steel.

It is frequently highly desirable, to form articles of iron, which may afterwards be superficially converted into steel. In the instance of rasps for the use of sculptors, it is indeed particularly necessary; as thereby, whilst the teeth on their surfaces, are as hard as usual, the rasps admit of being bent into any form of curvature, suitable to the intended purposes. The Editor, through the kindness of that eminent sculptor, the late Mr. James Smith, is now possessed of a half-round rasp, made in Italy, which fully possesses the admirable qualities above alluded to; and indeed, during the late war, such rasps were become exceedingly scarce and dear. Now it is evident that such rasps need only be made of iron, and their surfaces afterwards case-hardened in a slight degree, entirely to resemble the Italian rasps.

A similar advantage is likewise obtained, in forming slender articles of pure iron; such as that afforded by decarbonating cast-steel, and afterwards case-hardening them slightly; as thereby, their surfaces are fitted to receive a high polish, whilst their interior, still continues soft and tough; and, therefore, the articles are less liable to break in use, than if they were made of steel, or case-hardened throughout.

On Horse-nail-stub Iron, for gun-barrels, official seals, stop-cocks, &c.

Old horse-nails, which, to be fit for use, are necessarily made of the softest and toughest iron, are collected throughout the country, on purpose for this use: these are first agitated and rubbed against each other, in an angular box of iron, turning round continually, until the greatest part of the rust, which was upon them when collected, is rubbed off: they are then straightened, and driven tight into hoops of iron, with the heads and points opposite to each other, till the hoop will hold no more; when the mass is fit for being welded, and drawn out into bars, or into any other form, for use, as a very soft veined

iron, for making twisted gun-barrels and large office-seals, which latter, after being engraved, are case-hardened; and also for making stop-cocks, and other apparatus for performing experiments in chymistry, wherein mercury is employed, and the use of brass must be consequently excluded.

Improved mode of making Twisted Gun-barrels.

Instead of using horse-nail-stub iron alone, as in the last article, the gun-barrel makers now weld together bars of steely iron; such as the old sable Russian iron, and soft stub-iron, laid alternately upon each other in regular order; thus forming striped ribbands for the twisted barrels.

Where they wish, however, to produce curls, they first twist those compound bars, draw them into small square rods, and weld them, with the twists disposed in contrary directions, upon plates of plain iron, which forms the inside of the barrels; when the whole is drawn into ribbands, and used as before described.

Another beautiful variety is also produced by welding small square rods of striped iron, and others of twisted iron, upon plates of plain iron; thus producing a regular succession of striped and curled twists in the gun-barrels made thereof.

On annealing Iron and Steel, without oxiding or scaling it.

This is done by inclosing it in closed cast-iron vessels, and surrounding it with ground flint, such as is used in the manufactory of pottery; and then exposing the vessels to a red heat, in proper furnaces. It is likely that fine loam, might also answer for this purpose.

In this manner, Mr. Corcoran, of Mark-lane, wire-weaver, many years since, annealed his iron-wire so perfectly, that, although quite flexible, and pliant, yet it was as bright as though it had not been heated at all.

Another method is, to inclose it in melted lead, in cast-iron vessels; the surface of the lead being covered with charcoal, to prevent oxidation; and to let it nearly cool, before taking out the iron or steel. In this way, the late Mr. John Burr, millwright, of Hales-owen, in Shropshire, annealed steel-wire for the needle and fish-hook makers.

ENGLISH PATENTS.

To William Church, *of Birmingham, in the county of Warwick, Esq. for his invention of certain improvements in Machinery for Printing.*

In our sixth volume, we have given plates, and descriptions, of the very ingenious apparatus, invented by Dr. Church, for casting types, composing them into words and sentences, and afterwards printing the sheets of paper therefrom. The peculiarity of this invention, has

called forth considerable animadversion ; and the public press, has treated it with no small portion, both of ridicule and applause ; in many instances, equally resulting from an utter ignorance of the merits of the subject. A long procrastination, in bringing this invention into public use, has now caused it to sleep, (as many think, an "eternal sleep,") like some other subjects, which, perhaps, we may shortly revive, and send forward again to the light of day. It cannot, however, be a matter of surprise, that in surmounting the practical difficulties, which must present themselves, in the completion of machinery, that contemplates an extensive range of objects, considerable time should have elapsed ; many instances occur in the annals of mechanical art, in which inventions, founded upon the most indisputable principles of science, have never been realized, during the lives of their projectors. The steam-engine of Watt, was not brought to perfection, until the whole term of his patent-right had expired! It is, therefore, incumbent upon the public, to bear patiently, such delays as result from the unforeseen difficulties, to which almost every inventor is exposed, in bringing his views to perfection ; and to wait the period, however protracted, when the bright hopes of the aspiring genius, shall at length blaze out into maturity.

We have, involuntarily, been led to these general remarks, by the recollection of the contemptible ridicule, on the one hand, and the fulsome commendations on the other, to which Dr. Church's inventive talents, have been exposed, in the public prints ; and without intending to apply those remarks personally, have adopted them as a preface to the following subject.

The present patent, is for improvements, upon that part of the invention above alluded to, which comprises the printing press. The publication of this subject, has been delayed, under the expectation of being enabled to speak practically of its usefulness. We have now to state, that we have seen a printing press in operation upon this improved principle, which gives impressions equal to the best works of the most approved printing presses, and with a rapidity that is really surprising. We carefully watched its operation, for some time, when working under the disadvantage of inexperienced hands, and are in possession of a few sheets which were then printed at the rate of eighteen hundred per hour : we have no hesitation in saying, it is our firm belief, that, under favourable circumstances, three thousand impressions, per hour, might be struck off, without, in any degree, straining the machinery, and that these impressions would be of a superior order of printing.

The machine is worked by one man, who turns the fly-wheel, and two boys, who lay on the sheets of paper ; the inking of the types, the running in of the frisket, the rising and falling of the table and form, to produce the impression, and the delivery of the sheets, after being printed, into a heap, above the press, are all done by the evolutions of the mechanism ; which is so substantial, in all its parts, that there is little risk of its derangement ; and the movements are so smooth, that its action would scarcely be perceived in an adjoining room, or at a few yards distance.

The specification states, that these "improvements in machinery for printing, consist in variations, additions, and modifications of an apparatus for printing, described in the specification of a patent, &c. granted 21st of March, 1822." The improvements are embraced under the following heads: 1st, a method of adjusting and fixing the form of types upon the table, and of removing the same, and replacing other forms of types, with great expedition; 2dly, adapting a stationary surface, upon which, the paper intended to be printed, is laid and adjusted, ready to be drawn off, on to the frisket; 3dly, a mode of obtaining register with perfect accuracy; 4thly, the means, and apparatus, employed for confining the sheet of paper upon the frisket; 5thly, an interrupted gear motion, or mechanical contrivance, to effect a reciprocating action, by which certain parts of the machinery are alternately put in motion, or set at rest, while the other parts of the machinery, are continuing their progress; 6thly, the mode of taking off the sheet of paper, after it has been printed, and delivering the sheets, in succession, on to a heap, with perfect regularity; and 7thly, the mode of regulating, at pleasure, the quantity of ink communicated to the distributing rollers.

[*London Journal of Arts and Sciences.*

To Joseph Aspdin, *of Leeds, in the County of York, Bricklayer, for his new invented improvement in the mode of producing an artificial Stone.*

This cement or artificial stone, is proposed for the covering of buildings as stucco, and is suited either for dry situations or for water-works. The patentee designates the material Portland Cement, from its resemblance to Portland stone; its component parts are as follow: a given quantity of lime-stone, of the kind usually employed for mending roads, is to be pulverized by beating or grinding, or it may be taken from the road in a pulverized state, or in the state of puddle. This, when dried, is to be calcined in a furnace in the usual way. A similar quantity of argillaceous earth or clay is then to be mixed in water with the calcined lime-stone, and the whole perfectly incorporated by manual labour, or by machinery, into a plastic state. This mixture is then to be placed in shallow vessels for the purpose of evaporation, and is to be submitted to the action of the air, the sun, or the heat of fire, or steam conducted by pipes, or flues under the pans or evaporating vessels.

This composition, when in a dry state, is to be broken into lumps of suitable sizes, and is then to be calcined again, in a furnace similar to a lime-kiln, till the carbonic acid has been entirely expelled. The mixture so prepared, is then to be pulverized by grinding or beating, and when reduced to a fine powder, is in a fit state for use; and, with the addition of so much water as will be sufficient to bring

it into the consistency of mortar, will, when applied to its purpose, make a compact and durable artificial stone, equal to the Portland stone itself.

To James Russel, *of Wednesbury, in the County of Stafford, Gas Tube Manufacturer, for his invention of an improvement in the manufacture of Tubes for Gas and other purposes.*

These improvements, appertain to the peculiar mode of forming pipes and tubes of malleable iron, as practised by the patentee. He states, that he provides iron plates, previously rolled to a suitable thickness, and cut into strips of such length, as may be found desirable to constitute one piece of pipe or tube; the breadth of the strip, corresponding to the circumference of the tube intended to be formed.

The sides of the slips are then bent up by swages, or otherwise in the usual way, so as to bring the two edges as close together as possible.

This bent iron, or imperfect tube, is then introduced into a blast furnace, and when brought nearly into a state of fusion, is removed, and placed under a tilt hammer, for the purpose of welding the joint. The anvil, or the bolster fixed into the anvil upon which the tube is to be placed, has a semi-cylindrical groove formed in it, and the under side of the hammer has a corresponding groove. The imperfect tube is now slowly passed along under the tilt hammer, and by a succession of blows, the edges of the plate-iron become welded from end to end, and the tube rudely formed. The action of the tilt hammer is effected as usual; it vibrates upon pivots, and by the rotation of a wheel with projecting arms or cogs, which strike successively upon the end of the hammer, it is raised, and falling by its own gravity, produces the repetition of blows.

When the edges of the iron have been thus completely welded from end to end, the tube is to be again heated in a furnace as before, and then passed through a pair of grooved rollers. These rollers may have several circular grooves, suited to tubes of different diameters. The end of the tube, immediately as it comes out from between the rollers, is met by a conical or egg-shaped core, placed at the extremity of a stationary, horizontal rod, which egg-shaped core enters the open end of the tube, as it advances from between the rollers, and by sliding upon this core, the internal part, or bore of the tube, is formed to the exact diameter of the core, and rendered perfectly smooth; its external form, being determined by the grooved rollers.

The advantages which are proposed by this mode of manufacturing tubes and pipes, of wrought iron, for conveying gas, and other purposes, are, that the internal and external surfaces of the tubes will be perfectly cylindrical, and parallel to each other; and that the irregularities, occasionally arising from scales, and other obstructions, will be altogether avoided. The claim of invention, therefore, is not to be

considered as resting in the implements used in the operation, which are not new in themselves, either in form or character; but in the mode of operating, which, as respects the formation of pipes and tubes of malleable iron, is new.

To Cornelius Whitehouse, *of Wednesbury, in the county of Stafford, Whitesmith, for his invention of certain Improvements in manufacturing Tubes for Gas, and other purposes.*

The present patent is for improvements upon the above process, invented by a workman in the employ of Mr. James Russell, in whom, we understand, the interest of this patent is now become vested; Mr. James Russell is, therefore, the only manufacturer of these tubes.

The improvement consists in heating the pieces of iron of which such tubes are to be made, in a blast furnace, and immediately after withdrawing them from the furnace, passing them through swages, or other such instruments, in the following manner. First, provide a piece of flat iron, commonly called plough-plate iron, of a suitable substance, and width, according to the intended caliber of the tube; this piece is then prepared for welding, by being beat up on the sides, or, as it is commonly called, turned over, the edges meeting, or nearly so, and assuming the form of a long, cylindrical tube. This tube is then to be put into the fire and heated by a blast, and when the iron is upon the point of fusion, it is to be drawn out of the furnace by means of a chain attached to a draw-bench, and passed through a pair of dies of the size required; by which means, the edges of the iron will become welded together.

It is stated, that the process of welding these tubes, may be performed without the screw-press and dies above described, by employing a pair of pincers, in which a conical hole is made between the two chaps, for the tube to pass through; which will have a similar effect to the dies.

The superior quality of these tubes, compared to those made in the ordinary way, is stated to arise from the iron being considerably improved by the operation of the hollow fire, by which the heat is generally diffused through every part. The length of the pieces of tube thus made, is likewise an advantage, as by the above means, pipes or tubes may be made from two to eight feet long, in one piece; whereas, by the old modes, the lengths of tube cannot exceed four feet, without considerable difficulty, and consequently an increased expense. It is further stated, that the tubes are capable of resisting greater pressure, from the uniformity of the heat throughout, when they were welded; and lastly, that both their internal and external surfaces are rendered smooth, and greatly resemble drawn lead-pipes.

To ALEXANDER NESBITT, *of Upper Thames street, in the City of London, Broker, in consequence of a communication made to him by* WILLIAM VAN HOUTEN, *the younger, a foreigner, residing abroad, for a process, by which certain materials may be manufactured into Paper and Felt, or a substance nearly resembling coarse Paper or Felt; which material, so prepared, is applicable to various useful purposes.*

The material to be employed for this purpose, is moss, such as grows upon low heaths, and moors, in Holland; and which may be found, as the patentee supposes, in many parts of England. This moss is to be gathered, washed, cleaned, and dried, and then cut into short lengths in an engine, such as is employed for cutting tobacco. The cut moss, is then to be mixed up in the manner of preparing pulp, for making paper; and, when so mixed, is to be moulded into sheets, in a frame, as paper is moulded. The sheets are then to be pressed, in a heap, between blankets, and afterwards hung up to dry upon lines, as paper. When perfectly dry, the sheets are to be again pressed, in order to bring the material into close contact; and they may then be considered as fit for use.

This paper, or felt, is proposed to be employed for sheathing of ships' bottoms, between the wood-wook and the copper; and also for lining between the thicknesses of planking: it is proposed as an infallible preventive against leaking; as, upon the insinuation of water between the joints of the copper, or wood-work, this felt, or paper, will absorb the wet as a sponge, and thereby swelling, will fill the vacant spaces, and render the vessel water-tight.

Such a material has been employed, for some time, in the Dutch navy, and has been found perfectly efficacious in keeping the vessel dry; and so extremely durable is moss, that the patentee considers it will never decay, but will remain sound and effective as long as the wood-work of the ship lasts.

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. III.

BY PETER A. BROWNE, ESQ.

ON MECHANICS' LIENS.

Having, in the last number, enquired who are the parties to the contract, we shall next consider,

The persons with whom the contract is made.

The law of 1803, as I before mentioned, was a little defective in some of its provisions.

In order to create a lien, it required that the contract should be made with the *real owner*. The words are, "shall be subject to the payment of the debts contracted by the *owner* or *owners* thereof."

And, therefore, in the case of Steinmetz's Executors, *v.* Boudinot,

3 Sergeant and Rawle, 541, it was decided by the Supreme Court, that this act gave no lien, where the materials were furnished, by the orders of a person who had entered into articles of agreement with the owner of the land, for the purchase of the same, and was erecting the building; although such agreement was unknown to the plaintiff, and the defendant was ostensibly the owner of the building. The case was this, Boudinot was the owner of a lot; he contracted with one Bartle, by articles of agreement, to convey it to him on a ground rent at $5 a front foot; Bartle erected the building, and, in so doing, contracted the debt due to Steinmetz, which was for bricks used in the construction. The agreement made between Boudinot and Bartle was unknown to Steinmetz, at the time of the contraction of the debt. Bartle, was the ostensible owner, both of the ground and the building.

The next observation necessary to be made upon this law, (1806) is, that the words, "by the owner or owners thereof," found in the law of 1803, and upon which the difficulty took place, in the case of Steinmetz, *v.* Boudinot, before noticed, are omitted. There can be little doubt, but these words were *purposely* omitted by the legislature of 1806.

The act of 1803 reads thus, "That all, and every dwelling house, or other building, hereafter constructed and erected within, &c. shall be subject to the payment of the debts contracted '*by the owner or owners thereof*,' for, or by reason of, any work," &c.

That of 1806, thus, "That all and every dwelling house, or other building, hereafter constructed and erected within, &c. shall be subject to the payment of the debts contracted for, or by reason of, any work," &c.

Consequently, the decision in Steinmetz, *v.* Boudinot, that in order to create a lien under the law of 1803, the contract must have been made with the *real owner* of the building, does not apply to cases under the law of 1806. Under this latter law, it matters not whether the contract was made with the *real owner*, or not. Chief Justice Tilghman in delivering the opinions of the court in the case of Steinmetz, *v.* Boudinot, on this point, expresses himself in the following manner:—"When this act (of 1803) was made, it was very common for the proprietors of ground, to contract with a mechanic, of character, for the building of a house. The proprietor paid a certain sum of money for the building, when completed; and the mechanic purchased materials, and built the house, *on his own credit*. Now it is very clear, that in such case, the act (of 1803) created no lien.—This was found to bear hard in some instances, on persons who had furnished materials, or done work on a house; and therefore, by a subsequent act (passed March 17, 1806,) the lien was extended to all cases of work done, or materials furnished for a building, *whether on the credit of the owner or not*."

The *subject matter* of the contract:—

1. Repairing.
2. The actual use of the articles.
3. The contract of exchange of labour or materials.

By the words of the law, "all and every *dwelling house* or *other*

building," every edifice that can be erected, whether church, dwelling-house, barn, stable, or out-house, are included; and therefore, upon all of them, a lien may be created. But the debt must be contracted in the *erecting* and *constructing* of the house or other building, and no lien is created for *repairing* a building.

The words of the law are, "All and every dwelling-house or other building, hereafter *constructed* and *erected*, &c." And again, "for, or by reason of, any materials found, or work done for, or in the *erecting* and *constructing* such house or other building, &c."

And hence, in the case of the Olympic Theatre, 2 Browne, rep. 275, 284, it was decided that the act of *repairing* a building, or furnishing materials for that purpose, created no lien.

Under ordinary circumstances, it is very easy to determine, whether the work is done, or materials furnished for *repairing*, or for *erecting;* but cases may occur, when it will be difficult to come to a determination. For instance: suppose a part of a building were torn down and rebuilt; would this be repairing an old building, or constructing a new one? The answer to this question depends upon the construction to be put upon the words *erecting* and *constructing*; and that again depends upon the character of the statute in which they are found. One of the rules laid down, for the construction of statutes, is, that remedial statutes, or statutes against frauds, are to be liberally, and beneficially expounded: for although in *penal statutes*, a strict construction is required, by that humane principle of the law, which prefers that the judge should *acquit*, whom the legislature intended to *punish*, than that he should *punish*, whom the legislature intended to *discharge;* yet in giving relief against fraud, or in the furtherance and extension of natural right and justice, the judge may safely go beyond that which existed in the minds of those who framed the law. Now this is a *remedial* statute, of the most equitable kind, guarding an industrious and valuable part of the community, against the frauds, which were before, so often practised upon them; and giving them that security, which, above all others, is the most equitable—namely, upon the *thing* created by their labour and materials; in its construction, therefore, the judges have a *right* to be *liberal;* and it requires no great stretch of generosity to say, that where the *principal* part of a building is torn down, and rebuilt, it is a *construction* of a building.

Accordingly, in the case of the Olympic theatre, where the gable end of the old building was torn down, and a large additional building, communicating therewith, was erected, we find Judge Hemphill expressing himself as follows: "The court are further of opinion, that the act of *repairing* a house, creates no lien within the meaning of the legislature." "If the *principal part* of a building should be torn down, and rebuilt, upon a liberal construction of the act, it ought to be considered as creating a lien."

2. The actual use of the articles.

It is not necessary, in order to create a lien, that the materials should have been *actually used in the building;* if they are delivered

at, or *near* the building, at the place pointed out by the contracting party, *with an understanding of the parties, that they are to be used* in the *erection thereof*, a lien will be created in the building, although the articles are not used therein. The law does not require, *in terms*, that they should be used *in* the building; for it is in the alternative, "materials *for*, OR *in the erecting* and constructing," &c.; and the plain common sense, and common justice of the case require, that the honest mechanic, or material man, who has acted with the usual prudence exercised by men in his situation, should not be defeated of his lien by the fraud of others, not subject to his control.

The case of Wallace, *v.* Melchoir, was this: The defendant contracted with the plaintiff, who was a lumber merchant, for a quantity of lumber, to be used in the erection of a building. The lumber was delivered, from time to time, *at the building;* but was not used in the construction thereof; being, without the knowledge of the plaintiff, sold and delivered by the defendant, to different persons. The plaintiff entered his lien, agreeably to the act of Assembly. Hemphill delivered his opinion to the jury, as follows: "If you are satisfied, that Wallace's debt was contracted *for*, and on the *credit* of, the building; and that the lumber was delivered *at*, or *near*, the building, at the place pointed out by the defendant, *with an understanding of the parties that it was to be used in the erection thereof:* if, after that, the defendant did not use the lumber in the building, but, without the knowledge or consent of the plaintiff, sold it to other persons, still Wallace had a lien on the building for his debt."

And if the materials are not even furnished, *at* or *near* the building, but at a distance from it, *provided it is in the usual course of business*, a lien is effected on the building, although they are not actually used therein. The material man, having, *bona fide*, sold the articles *for* the erecting of the building, and delivered them *in the usual course of trade*, for instance lumber at the carpenter's shop, he is not obliged to incur the risk of their application.

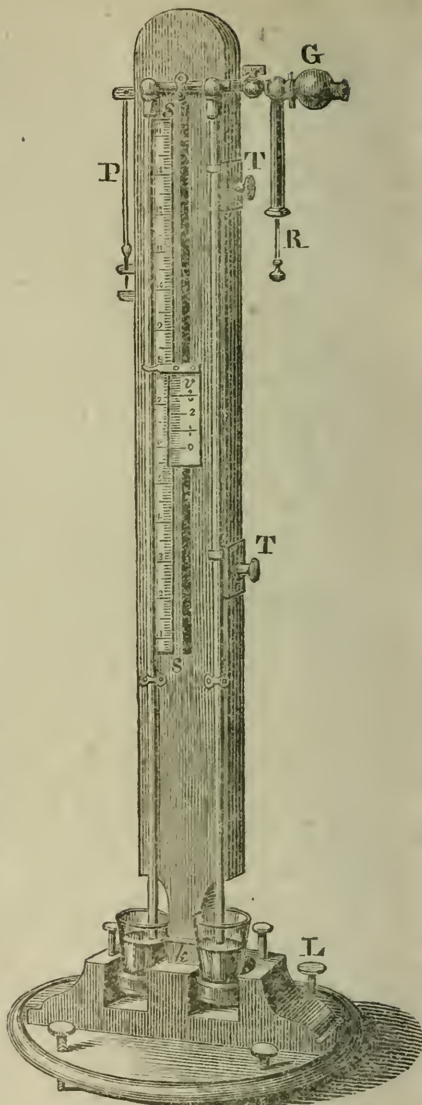
This was decided in the case of Hinchman, *v.* Graham. 2nd Sergeant and Rawle's Reports, 170.

ON SPECIFIC GRAVITY.—No. III.

By ROBERT HARE, M. D. *Professor of Chymistry in the University of Pennsylvania.*

ON THE LITRAMETER.

This name is derived from the Greek litra, weight, and meter, measure; and is given to one of the instruments which I have contrived for



ascertaining specific gravities. The litrameter owes its efficiency to the principle. that when columns of different liquids are elevated by the same pressure, their weights must be inversely as their gravities.

Two glass tubes, of the size and bore usually employed in barometers, are made to communicate internally, with each other, and with a gum elastic bag, (G) by means of a brass tube and two sockets of the same metal, into which they are severally inserted. The brass tube terminates in a cock, to which the neck of the bag is tied. Between the cock and the glass tubes, there is a tube at right angles to, and opening into, that which connects them. At the lower end of this tube, a small copper rod (R) enters, through a collar of leathers.

The tubes are placed vertically, in grooves, against an upright strip of wood, tenanted into a pedestal of the same material. Parallel to one of the grooves, in which the tubes are situated, a strip of brass is fastened; and graduated, so that each degree may be about equal to $\frac{1}{220}$ of the whole height of the tubes. The brass plate is long enough to admit of about 140 degrees. Close to this scale, a vernier (v) is made to slide, so that the divisions of the scale are susceptible of sub-division into tenths, and the whole height of the tubes, into about 2200 parts, or degrees.

On the left of the tube, there is another strip of brass, with another set of numbers, so situated, as to comprise two degrees, of the scale

above-mentioned, in one. Agreeably to this enumeration, the height of the tubes is, by the aid of a correspondent graduation on the vernier, divided into 1100 parts, or degrees.

A small strip of sheet tin, (k) is let into a kerf in the wood, supporting the tubes, in order to indicate the commencement of the scale; and the depth to which the orifices of the tubes must extend. At distances from this, of 1000 parts, and 2000 parts, (commensurate with those of the scale) there are two other indices, (T, T,) to the right hand tube. Let a small vessel, containing water, be made to receive the lower end of the tube, by the side of which the scale is situated; and a similar vessel of any other fluid, whose gravity is sought, be made to receive the lower end of the other tube; so that the end of the one tube, may be covered by the liquid in question, and the end of the other tube, by the water.

The bag being compressed, a great part of the contained air, is expelled through the tubes, and rises through the liquids in the tumblers. When the bag is allowed to resume its shape, the consequent rarefaction allows the liquids to rise into the tubes, in obedience to the greater pressure of the atmosphere, without. If the liquid to be assayed, be heavier than water, as, for instance, let it be concentrated sulphuric acid, it should be raised a little above the first index, at the distance of 1000 degrees from the common level of the orifices of the tubes. The vessels holding the liquids, being then removed, so that the result may be uninfluenced by any inequality in the height of the liquids, the column of acid must be lowered, until its upper surface coincide, exactly, with the index of one thousand. Opposite the upper surface of the column of water, the two first numbers of specific gravity of the acid, will then be found; and, by duly adjusting and inspecting the vernier, the third figure will be ascertained. The liquids should be at the temperature of sixty.

If the liquid under examination, be lighter than water, as in the case of pure alcohol, it must be raised to the upper index. The column of water, measured by the scale of 1000, will then be found at 800 nearly; which shows, that 1000 parts of alcohol, are, in weight, equivalent to 800 parts of water—or, in other words, 800, is ascertained to be the specific gravity of the alcohol.

The sliding rod and tube at R, between the cock and the glass tubes, facilitates the adjustment to the index, of the column of liquid in the right hand glass tube. When the rod is pushed in, as far as possible, it causes a small leak, by which the air enters; and the columns of the liquids, previously raised too high, by the bag, may be allowed to fall, till the liquid, which is to be assayed, is near the index. Then, by pushing the rod in, they may be gradually lowered, and adjusted to the proper height, with great accuracy.

A rod of this kind, graduated, might answer the purpose of a vernier.

Instead of a simple bag of Caoutchouc, I have used one with two valves; one opening from the tubes into the bag, the other, from the bag, into the air.

But upon the whole, I find a syringe preferable; the adjusting rod being included in the rod of the piston, which is perforated for its reception, and furnished with a stuffing box, to render it air tight.

The plummet P, and the screws at L, enable the operator to detect, and rectify any deviation in the instrument, from perpendicularity.

Erratum in the first number of this Journal.—In page 45, line 13th from the bottom, for "the weight of this, divided by the weight of the others," *read*, dividing by the weight of this, the weights of the others.

An account of the Hydrostatic Blowpipe, as now used in the Laboratory of the University of Pennsylvania, by the inventor, R. Hare, *M. D. Professor of Chymistry, &c.*

The following passage is quoted from a memoir on the supply and application of the Blowpipe, which I published in 1802:—

"The blowpipe is, on many occasions, a useful instrument to the artist, and philosopher. By the former, it is used for the purpose of enamelling, to soften or solder small pieces of metal, and for the fabrication of glass instruments; while the latter, can, by means of it, in a few minutes, subject small portions of any substance to intense heat; and is thus enabled to judge of the advantage to be gained, and the method to be pursued, in operations on a larger scale. It is by means of the blowpipe, that glass tubes are most conveniently exposed to the heat necessary to mould them into the many forms occasionally required, for philosophical purposes; and by the various application of tubes, thus moulded, ingenuity is often enabled to surmount the want of apparatus; which is the greatest obstacle to the attainment of skill, in experimental philosophy.

"To all the purposes which I have mentioned, the blowpipe is fully adequate, when properly supplied with air, and applied to a proper flame: but it appears that the means which have hitherto been employed to accomplish these ends, are, more or less, defective.

"The most general method, is that of supplying this instrument with the breath. In addition to the well known difficulty of keeping up a constant emission of air during respiration, and its injurious effect upon the lungs,* it may be remarked, that as the breath is loaded with moisture, and partially carbonized, it is proportionably unfit for combustion; and, the impossibility of supporting a flame with oxygen gas, by this method, is obvious.

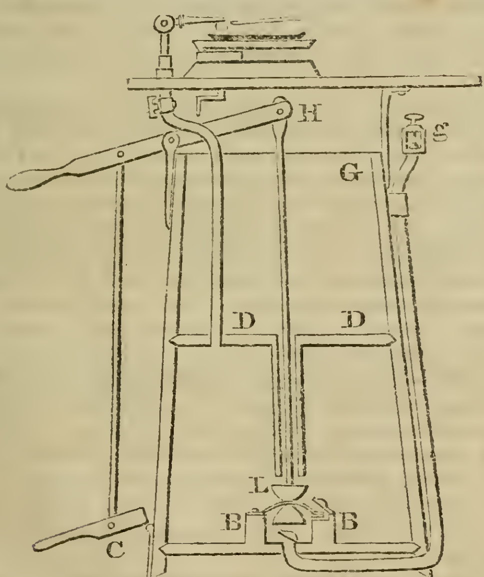
"Another way of supplying the blowpipe with air, is that of connecting with it, a small pair of double bellows. A contrivance of this kind, possesses obvious advantages over the mouth blowpipe; but, owing to the pervious nature of the materials of which bellows are constructed, and the difficulty of making their valves air tight, the greater part of the air drawn into them, escapes at other places than the proper aperture. A pair of bellows, of this kind, belonging to an artist of this city, which were not considered as less air tight than usual, were found to discharge the complement of their upper compartment, in six-sevenths of the time, when the orifice of the pipe was open, which was requisite when it was closed. Hence, it appears that

* In consequence of this, some artists have abandoned the use of the instrument.

six-sevenths of the air ejected into the upper compartment, escaped at other places than the proper aperture; and if to this loss were added that sustained by the lower compartment, the waste would be much greater. As in operating with these machines, it is necessary constantly to move the foot, the operator cannot leave his seat; and, in nice operations, the motion of his body is an inconvenience, if not a source of failure. Bellows of this kind cannot be used for supplying combustion with oxygen gas; because, as this air is only to be obtained by a chemical process, it is very desirable to avoid any waste of it; and, as there is always a portion of air remaining in them, even when the boards are pressed as near to each other as the folding of the leather will permit, any small quantity of oxygen gas which might be drawn into them, would be contaminated.

"Being sensible of the advantage which would result from the invention of a more perfect method of supplying the blowpipe with oxygen gas or atmospheric air, I was induced to search for means of accomplishing this object. The result of my attention to the subject, is the production of a machine, of which there follows an engraving and description."

The machine, which the following figure represents, does not differ essentially from that alluded to, in the passage above quoted. The construction is, however, more simple and easy.



Explanation of the figure.

The *Hydrostatic Blowpipe*, consists of a cask, divided by a horizontal diaphragm, into two apartments (DD.) From the upper apartment, a pipe of about three inches in diameter, (its axis coincident with that of the cask,) descends, until within about six inches

of the bottom. On this is fastened by screws, a hollow cylinder of wood (BB.) externally twelve inches, internally eight inches, in diameter. Around the rim of this cylinder, a piece of leather is nailed, so as to be air tight. On one side, a small groove is made in the the upper surface of the block, so that a lateral passage may be left under the leather when nailed on each side of the groove. This lateral passage, communicates with a hole bored vertically into the wood, by a centre-bit; and a small strip of the leather, being extended so as to cover this hole, is made, with the addition of some disks of metal, to constitute a valve, opening upwards. In the bottom of the cask, there is another valve, opening upwards. A piston rod, passing perpendicularly through the pipe, from the handle (H.) is fastened near its lower end, to a hemispherical mass of lead (L.) The portion of the rod beyond this, proceeds through the centre of the leather, which covers the cavity formed by the hollow cylinder; also through another mass of lead, like the first, which being forced up by a screw and nut, subjects the leather, between it, and the upper leaden hemisphere, to a pressure sufficient to render the juncture air tight. From the partition, an eduction pipe is carried under the table, where it is fastened, by means of a screw, to a cock which carries a blowpipe, so attached, by a small swivel joint, as to be adjusted into any direction which can be necessary. A suction pipe passes from the opening covered by the lower valve, under the bottom of the cask, and rises vertically, close to it, on the outside—terminating in a gallows, (g) for the attachment of any flexible tube which may be necessary.

The apparatus being thus arranged, and the cask supplied with water, until the partition is covered, to the depth of about two inches, if the piston be lifted, the leather will be bulged up, and will remove, in some degree, the atmospheric pressure from the cavity beneath it; consequently, the air must enter through the lower valve, to restore the equilibrium. When the piston is depressed, the leather being bulged, in the opposite direction, the cavity beneath it is diminished, and the air, being compressed, forces its way through the lateral valve into the lower apartment of the cask. This apartment being previously full of water, a portion of this fluid is pressed up, through the pipe, into the upper apartment. The same result ensues every time that the stroke is repeated; so that the lower apartment soon becomes replete with air, which is retained by the cock, until its discharge by the blowpipe is requisite.

The cock being opened, the air confined in the lower apartment, is expelled by the pressure of the water in the upper apartment, which, as the air which had displaced it escapes, descends and re-occupies its former situation. The piston is worked either by the handle, or the treadle, at C.

In order to supply the cask with oxygen gas, it is only necessary to attach to the suction pipe, (by means of the gallows and screw at g,) another pipe, duly flexible, and passed under a bell containing the gas in question, over the pneumatic cistern. Or the pipe may communicate with a leather bag, filled with oxygen. I have one, which will hold fifty gallons; the seams are closed by rivets, agreeably to Pennock & Sellers' plan for mail bags, or fire-hose.

Having used the Hydrostatic Blowpipe for five and twenty years, I am enabled to speak in favour of its conveniency, with the confidence due to this long trial. I am persuaded, that it would be found exceedingly useful, to all artists who employ the blowpipe in soldering, or in blowing, or moulding the tubes of thermometers, barometers, and other processes, to which the enamellers' lamp is applied.

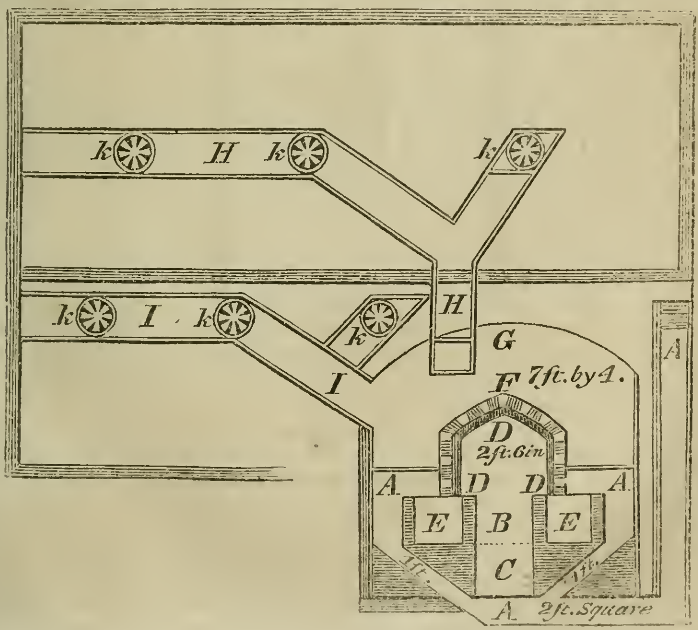
Associated with the large self-regulating reservoir of hydrogen, to be described in the next number of this Journal, it is, with the aid of a jet of atmospheric air, supplied to it in the compound blowpipe, competent to fuse platina; and the facility with which the hydro-oxygen flame thus produced, may be made to act in any convenient direction, would render it highly serviceable to silversmiths, coppersmiths, and pewterers. In soft soldering, it is often far more efficacious than a soldering iron. Its peculiar cleanliness is worthy of attention; in this respect, it greatly excels the ordinary blowpipe flame. Besides, the limits are peculiarly ample, within which it is susceptible of an instantaneous increase, or diminution, in size or intensity.

I do not believe the heat produced in this way, to be much more expensive than that produced by a lamp.

[TO BE CONTINUED.]

WARMING ROOMS BY HEATED AIR.

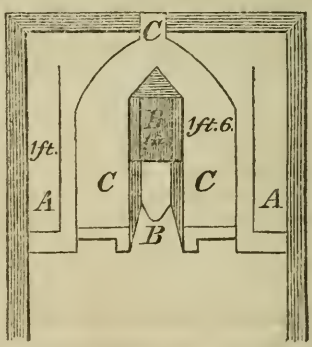
The following mode of warming large rooms, with hot air flues, is very economical, and has had its utility established by the ordeal of a fair trial.



For eight years I did business, daily, in a room 70 feet by 30 feet, and, during winter, with two very large fires; but the room was never comfortably warm ten yards from the fires. The mode of heating by flues was then adopted; and the same room, as well as another, 60 feet by 21, has been ever since, (now more than four years,) kept at a regular heat of 55 degrees by one fire, which supplies the flues with hot air. The saving in fuel is very great; while four fires, on the old plan, for the two rooms, would consume twenty chaldrons yearly, this method requires only eight chaldrons, making a saving of twelve. The whole expense of laying down the flues, building the cellar, &c. was about one hundred pounds sterling.

The following rough description will, perhaps, make the mode of proceeding clear to your readers:

The drawing prefixed to this article, shows the two rooms, one 70 feet by 30, and to the square of the roof 18 feet; the other, 60 feet by 21, and to the square of the roof 12. Also, a third apartment, (the cellar beneath,) containing the fire-place that furnishes the hot air to the rooms. A, is the cold air flue; B, fire-place; C, ash-place; D, iron retort; E, smoke flue; E, 4½ inches brick-work round the retort, with small pots, similar to chimney-pots, 2 inches in diameter, to admit the cold air to the retort, and to let it into the hot air chamber, when heated; G, the hot air chamber; H, hot air flue into the large room; I, ditto into the small room; K, ventilators to regulate the heat.



The additional figure here inserted, is an elevation of the fire-place. A is the cold air flue; B, the fire-place; and C, the smoke flue.

[*English Magazine.*

ON THE FIGURE OF THE EARTH.

The subjoined Review is taken from the London Quarterly Journal of Science and the Arts, for which work it was written, and is from the pen of Professor James Renwick, of Columbia College, New-York. It will, perhaps, be thought by some persons, that the subject is too

abstruse for a Journal devoted principally to the promotion of the mechanic arts; but, while the Editor will constantly keep this object in view, he has been careful to reserve a place for "general science." In selecting articles of this description, those only will be chosen, which treat their subjects in a manner, sufficiently popular, to be understood by intelligent, though unlearned readers. Such, in the opinion of the Editor, is the review before us. It is written in a style of peculiar clearness, well calculated to give to the general reader, a correct view of the nature and importance of the operations detailed in Captain Sabine's work. It is believed to contain more information upon the subject of the experiments, which have been instituted to determine the true figure of the earth, by means of the vibration of the pendulum, and thence to obtain a correct standard of lineal measurement, than is elsewhere to be found in the same compass.

An account of experiments to determine the figure of the Earth, by means of a pendulum, vibrating seconds, in different latitudes, and on various other subjects of philosophical inquiry. By Captain Edward Sabine, F.R.S., &c.

[The following Review of the first part of Captain Sabine's work; namely, of his Experiments on the Figure of the Earth, has been transmitted to us from a correspondent in the United States. We are glad to perceive that the works of British Science, are so quickly, and so justly appreciated, on the other side of the Atlantic.]

[*London Quarterly Journal.*

From the time of the first cultivation of science, the size and figure of the earth, have been objects of inquiry. To an ignorant and superficial observer, it presents the appearance of an extended plane; to the earliest cultivators of astronomy, it showed an evident curvature in the direction of the meridian; and it was not long before a curvature in a transverse direction, was also detected by means of a difference in the apparent time of the occurrence of lunar eclipses, in different places; hence, the earth was justly inferred to be of a figure nearly spherical. Other observations have confirmed the near approach of this inference to the truth; the shape of the section of the shadow in lunar eclipses, is always circular; the appearance of great expanses of water, is manifestly spherical. Ships, in departing from the shore, are hidden by the curvature of the earth, long before distance alone, could render them invisible: and Humboldt, upon the Peak of Teneriffe, observed an angle of 92° between his visible horizon and the zenith. All these, and innumerable other facts, lead to the confirmation of the received opinion, that the earth is, if not an exact sphere, of a shape that differs but little from that regular geometric solid.

Were the earth at rest in space, and had it originally existed in a fluid state, its several particles would, by their mutual attraction, have arranged themselves in a spherical form; had the matter of

which it is composed, been incompressible and homogeneous, this sphere would have been of equal density throughout; but if its substance had admitted of compression, the outer portion would have been the most rare, and the mass would have increased gradually in density, to the centre.

But the form of the earth, is affected by another circumstance. When a body is made to revolve around a fixed axis, its several particles describe circles, whose planes are perpendicular to, and whose centres are in, the axis. In this way, all the particles, excepting those situated in the axis itself, become affected by a centrifugal force, that, did no other power oppose its action, would cause them to fly off in tangents to the curves in which they revolve: this force, is in each particle, proportioned to the radius of the circle it describes. In solid bodies, the attraction of aggregation is, generally speaking, sufficient to prevent any disintegration, as a consequence of the action of the centrifugal force; and in the larger masses of matter, whether solid or fluid, the attraction of gravitation produces the same effect. Our earth is a body that is in a state of rapid rotatory motion, performing a complete revolution around its axis, in the space of a sidereal day. Each point upon its surface is therefore acted upon by a centrifugal force. This is greatest at the equator, and becomes zero at the poles; and although the attraction of gravitation, is far more than sufficient to render this centrifugal force of no effect, in throwing off any portion of the matter, of which the earth, or its surrounding atmosphere, is composed, it is yet rendered manifest, by a diminution in the intensity of the force of gravity. This diminution of the intensity of gravitation, will affect the rate at which heavy bodies fall to the surface of the earth, and the time of the oscillations of pendulums. It was first observed by Richer, a French astronomer, who visited Cayenne, in 1672, for the purpose of making astronomical observations; he was furnished with a clock that marked mean solar time, in the latitude of Paris; and, to his surprise, he found, that at Cayenne, in lat. 5° N. its rate had become 2′ 28″ per day, too slow. As this was a far greater change than could be accounted for, by any alteration in the length of the pendulum, caused by difference of temperature, no explanation remained, excepting that furnished by the opposition of the centrifugal force, to the attractive power of the earth. The centrifugal force, as has already been stated, is proportionate, at any point of the earth's surface, to the radius of the circle described by that point, in its diurnal revolution, or to the cosine of the latitude: but this is not the measure of the diminution it causes in the intensity of gravitation; for the latter, acts in the direction of a radius of the terrestrial sphere, while the former, is parallel to an equatorial diameter: on account of this obliquity of action, the diminution in the force of gravity, arising from the diurnal rotation of the earth, is every where proportioned, not to the cosine of the latitude simply, but to its square.

The investigations of Newton, and Huygens, into the laws that regulate the action of central forces, furnish us with means, by which, the relation between the whole gravitating force of the earth, and its diminution at the equator, under the action of a centrifugal force.

may be determined: supposing the earth to be a sphere, this ratio is that of 289 to 1; but in consequence of the flattening of the earth at the poles, and its increased diameter at the equator, of which we are about to speak, this relation is changed, and the centrifugal force bears a somewhat higher proportion to that of gravitation. A great part of the surface of the globe, is covered with water, and many of the hypotheses of geologists suppose that the earth was originally in a liquid state. The figure of the earth, and the curvature of its surface, is that which the surface of the great mass of water spontaneously assumes; and hence grew the belief, that the shape of our globe cannot be that of a perfect sphere; for were the solid nucleus of the earth perfectly spherical, the waters of the ocean must have accumulated themselves, by virtue of the centrifugal force, in a zone, on each side of the equator.

In order that a mass of fluid, acted upon by its own gravitation, and the centrifugal force arising from its rotation around an axis, should be at rest, and have no tendency to move towards either its poles or its equator, it is necessary that the pressure of all the columns of fluids, extending from the centre to the surface, should be equal to each other. These several columns, if enclosed in tubes communicating with each other at the centre, would therefore be in equilibrio; but a column beneath the equator, being formed of matter, whose gravity is diminished by the centrifugal force, must be longer than one terminating at the pole, and the lengths of the intermediate columns must vary according to their latitude. The figure that would result from such a state of equilibrium, was investigated by both Newton and Huygens, but upon two different hypotheses. Newton conceived the force of gravity to arise from the mutual attraction of all the particles that compose the earth, acting upon each other with forces inversely proportioned to the squares of their respective distances; he thence inferred that this force was not a constant one, and that if the figure of the earth was due to the attraction of gravitation, the intensity of this force at different points, was affected by the earth's figure. The earth being once flattened by the centrifugal force, this very change of figure, would render the force of gravity at the equator, the least intense: applying this theory to a homogeneous spherical mass, and assuming, most happily, that an ellipsoid, of revolution, would fulfil the conditions of equilibrium, he inferred that the proportion between the polar and equatorial diameters, was as 229 to 230, and the compression $\frac{1}{230}$ part of the greater axis. Huygens, on the other hand, denied that the particles were mutually attractive of each other; and assumed, that each particle tended towards the common centre, with a force inversely, as the square of its distance from that point; by means of this hypothesis, he concluded that the curve, by whose revolution the terrestrial spheriod was generated, was not a conic-section, but a curve of the fourth order, although when the centrifugal force bore but a small proportion to gravity, it would not differ, sensibly, from an ellipsis. He found the proportion, between the greatest and least diameters of this curve, to be as 577 to 578, and a consequent ellipticity of $\frac{1}{578}$.

Different as are these two hypotheses, and their results, there is still one remarkable accordance between them; for by both, the sum of the fractions that express the ellipticity, and the excess of gravity at the pole, over that at the equator, are identical.

The hypothesis of Huygens is now exploded, inasmuch as the mutual attraction of all gravitating bodies, is admitted; but his investigation is not of the less value; for it gives the flattening that would take place, under the received law of attraction, provided the earth were composed of concentric shells, infinitely rare at the surface, and infinitely dense at the centre: and as Newton's investigation gives the compression, in the case of uniform density, we have thus the extreme limits, between which, every possible difference in the ellipticity of the earth, that can arise from a difference in its internal constitution, must be comprised.

The inferences of Newton, were confirmed by Clairaut; who furnished strict demonstrations of two propositions, assumed by that great philosopher. These are, 1st, that the elliptic figure, satisfies the conditions of equilibrium; and 2d, that the centrifugal force varies with the square of the cosine of the latitude. He also demonstrated a theorem, that has since been of much use in determining the shape of the earth, from observations on the intensity of gravity. This important theorem is as follows, viz.: *The sum of the two fractions, one of which represents the ellipticity of the earth, and the other, the ratio of the force of gravity at the poles, to that at the equator, is equal to 5-2 of the fraction expressing the ratio of the centrifugal force at the equator, to the force of gravity.*

We are only acquainted with the mere crust of the globe we inhabit; but reasoning from the nature of the substances of which it is composed, we might infer an increase in its density, between the surface and the centre. The same inference may be drawn from the experiments of Cavendish, with the balance of Torsion, and the observations of Maskelyne, on the attraction of the mountain Schehallion: from these different methods, a mean density may be inferred, of not less than four and a half times that of water, while the outer shell has a specific gravity considerably below 3. La Place, too, assuming the density of the surface, to be three times that of water, has inferred a mean density of 4.746. It will, therefore, be evident, that the ellipticity ought to be less than $\frac{1}{230}$; but the mere application of the calculus, does not furnish the measure of its true amount; for we are ignorant of the nature of the substances under investigation, and the circumstances under which they were first united in one mass. Had the earth been originally a fluid, with a compressibility equal to that found to exist in water, by the experiments of Canton, the ellipticity would have been $\frac{1}{560}$; but this hypothesis is probably wide of the truth, and the inferred ellipticity, consequently incorrect.

In order to ascertain the real figure of the earth, it is absolutely necessary to have recourse to experiment and observation. The method that would at first appear most obvious, is that of actually measuring a portion of one of its meridians; should its degrees be found all equal, a truly spherical figure might be inferred; should

they decrease from the equator to the pole, an elongation would be proved; but should the degrees nearest to the pole, be found the longest, no doubt need be entertained that the earth is flattened in the direction of its axis of revolution. With these views, a portion of a meridian, extending from Dunkirk, to the southern frontier of France, was measured by Picard and Cassini. The apparent result of this operation, led to conclusions totally different from those deduced from the theory of gravitation, and the laws of central forces. The southernmost degrees of this arc, appeared to be the longest; and thus ground was afforded for the belief, that the earth was an oblong, instead of an oblate spheroid.*

The measure of Picard and Cassini, being at variance with the received hypothesis, but the instruments, and methods of the age, being insufficient to discover the error, it was proposed, by way of ascertaining the truth in the most unexceptionable manner, to measure a degree under the equator, and another, as near to the pole as was practicable. With this view, Maupertius, was sent to Lapland, and Condamine, to Peru. Their measures confirmed the general theory of Newton, in manifesting the oblateness of the earth. The degree of Maupertius, compared with those, measured in France, gave for the fraction expressing the degree of oblateness, $\frac{1}{178}$; but by a recent measure of the same degree, by Soanburg, an error of more than 200 toises, in excess, has been detected; and the determination of this astronomer, compared with degrees measured in France, reduces the flattening to $\frac{1}{304}$. The French arc, has subsequently been extended into Spain, and as far south, as the island of Formentera. In England, an arc of three degrees, extending from Dunnose, in the Isle of Wight, to Clifton, was measured by General Mudge; and it has since been extended as far as Unst, one of the Shetland Islands. Various other arcs have been measured, at different times; as at the Cape of Good Hope, by La Caile; in Pennsylvania, by Mason and Dixon; in Italy, by Boscovich; in Hungary, by Liesganig; and in India, by Lambton. If many of the contiguous partial arcs, show an elongation, still, all, when compared with others, at a considerable distance, to the north or south, show a flattening towards the poles: but, although this may be considered as fully established, there yet remains very considerable doubt as to the value of the fraction, that expresses the relation between the polar, and equatorial diameters, of the generating ellipsis; the results, obtained by comparing the different measurements with each other, varying so greatly, as scarcely to have narrowed the question within the limits in which it had been reduced by the hypothesis of Newton and Huygens, and the demonstrations of Clairault.

This variation, particularly where recent measures are concerned, is not attributable to a deficiency, either in the observers, the instruments, or the methods of observation and calculation. It appears to be

* The same arc, has since been more correctly measured, by Mechaine and Delambre, towards the end of the last century, by which a different result was obtained; giving the fraction $\frac{1}{203}$ for the flattening at the poles.

occasioned principally, if not entirely, by the deflection which the plumb-line undergoes, from the unequal density of the materials near the surface of the earth, and which affects the celestial determination of the latitude at the extremities of the measured arc; no means are, as yet, known, by which the errors thus occasioned, may be avoided; or their amount ascertained, and allowed for. It is to their influence, that we must ascribe the fact, that by combining together the French and British surveys, whereby an arc, of nearly a fourth of the quadrant of the meridian, is obtained, the ellipticity deduced, is much greater than would appear from a comparison of the separate degrees of this very arc, with those measured near the equator. If a precise determination of the figure of the earth, can ever be hoped for, by the measurement of portions of the meridian, it can only be, by the comparison of arcs of very considerable extent; certainly, of not less than five degrees, accomplished at parts of the meridian, extremely distant from each other.

Other methods, however, exist, that are liable to less uncertainty. The accumulation of matter, in the equatorial regions, modifies the action of the earth upon the moon; insomuch, that the motion of the latter is affected by two irregularities—one, in latitude; and the other, in longitude. The maximum effect of these equations, may be determined by observation; and hence, the extent of the cause may be investigated. The calculation has actually been made, by Bouvard, Burg, and Burkhardt, at the instance of La Place, and gives an ellipticity of $\frac{1}{306}$. This method has a great advantage over actual measurement; for it is independent of irregularities on the surface of the earth, or of inequalities in its internal constitution.

Observations upon the length of the pendulum, beating seconds, in different latitudes, also furnish a method by which the compression may be determined. The length of the seconds' pendulum, may be demonstrated, to be exactly proportioned to the force of gravity, at the place of observation. The comparison of such observations at different latitudes, will afford the data for calculating the lengths of the pendulum at the pole, and beneath the equator: these, being respectively proportioned to the gravitating forces, at these places, give the numerator and denominator of a fraction, that subtracted from $\frac{5}{2}$ of $\frac{1}{289}$, furnishes an expression for the oblateness of the generating ellipse, in conformity with the theorem of Clairaut. This mode of determining the figure of the earth, is better, for several reasons, than that of ascertaining the same fact, from the measure of degrees; whether distant, or contiguous.

It has been shown, by the investigations of La Place, that the term of the formula, in which error may arise from the causes of anomaly, has a coefficient, that is, five times as great, when the ellipticity is inferred from degrees of the meridian, as it is, when it is determined from the lengths of the pendulum in different latitudes. The mode of ascertaining the length of the pendulum vibrating seconds, has been of late years so much improved, as to have become a very simple experiment, that may be well performed by a single compe-

tent observer; while the measure of a degree of the meridian, is a laborious, tedious, and expensive process.

The work, whose title appears at the head of the present article, is, for the most part, occupied with an account of experiments made to determine the length of the pendulum, vibrating seconds, in different latitudes, and in both hemispheres. They were performed during two voyages made in public vessels, and in the employ of government: in the first, the author visited, and performed experiments at Sierra Leone, St. Thomas', the islands of Ascension, Bahia, Maranham, Trinidad, Jamaica, and at New York; during the second, he landed, and experimented at Hammerfest, Fairhaven in Spitzbergen, on the coast of Greenland, and at Drontheim.

The method principally relied upon by our author, and employed by him at all his stations, is the same which was previously used by Captain Kater, at the several stations of the British Trigonometrical Survey, as detailed by him, in the *Philosophical Transactions*, for 1819. The fundamental experiment of this method, consists in suspending a pendulum alternately, from two knife edges; one, in the usual position of the centre of suspension; the other, near the lens of the pendulum: the vibrations of the pendulum, when suspended from these two distant points, are rendered isochronous, by a change in the position of a small weight, that slides along the pendulum rod; the point near the lens, is thus rendered the centre of oscillation, in consequence of a property of the pendulum, discovered by Huygens; who demonstrated, that the centres of oscillation, and suspension, were convertible points. The distance between the knife edges, may be measured with great accuracy, by means of microscropes attached to accurate scales; giving thus the true length of the experimental pendulum: the number of oscillations it performs in any given time, may be ascertained by comparison with the pendulum of a well-regulated clock; and hence, the length of the pendulum, vibrating seconds, at the place of experiment, may be determined, by applying the well known proposition, that the lengths of pendulums are inversely, as the squares of the numbers of their respective vibrations, in equal times. After the length of the seconds' pendulum, has been thus determined, in any one place, by experiments sufficiently multiplied to ensure against any probable error, another pendulum, of similar shape to the first, with the exception of its having no moveable weight, and but one knife edge, which is situated at the usual centre of suspension, is employed. This pendulum may be hung up in front of the clock, with which the original experiment was made; or of some other whose rate is known, and which is placed in the same apartment: its rate of oscillation, may be thus known, and its length calculated, upon the same principle as that which we have stated, as the mode in which the length of the seconds' pendulum, was originally determined. The length of this last mentioned experimental pendulum, being thus ascertained, and with an accuracy equal to that of the fundamental experiment, it may be carried from station to station; the number of its vibrations, in a given time, as shown at each station, by comparison with an astronomical clock, will furnish data,

whence the length of the pendulum, vibrating seconds at that place, may be calculated. This method is, undoubtedly, the best that has hitherto been proposed; and we are not prepared to say that it is susceptible of any material improvement, in the theoretic part. The manner of construction, or even of using the instrument, may perhaps undergo change; (the latter, has undergone a very important change, since its first employment by Captain Kater, in the improved method suggested by Captain Sabine, and adopted by him, of observing the coincidences,) but we cannot fairly anticipate, that any principle more beautiful, or more readily reduced to practice, is likely to be discovered.

[TO BE CONTINUED.]

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir—Should you think the subjoined extract of a letter, worthy of insertion in your Journal, you are at liberty to publish it. Perhaps you are in possession of further information on the subject, or may think it worth while to obtain it from the patentee.

Yours, &c. W.

Extract of a letter from Baltimore, dated Feb. 20th, 1826.

"Since my return I have made further inquiries in relation to the 'Baltimore patent Roofing;' the inventor, a member of our academy, possessing a considerable stock of knowledge, is a manufacturer of oil floor cloth; he informed me, that his attention was turned towards the subject, by the following circumstances:—About nine years ago, he covered part of the roof of his 'paint grinding establishment' with such small pieces of the oil cloth, as are cut off in fitting it to apartments, and that several years afterwards, he found it was tighter than any other part of the roof. He thence concluded, that, as the kind intended for flooring, had lasted so well, he might, by the application of a stouter canvass, and of a composition, better calculated to resist the effect of the action of the weather, form a roofing of a very durable nature. He now believes he has succeeded. There are many advantages connected with it; among others, are the quickness with which it may be put on, the little liability to leaking, from being in one piece, for an ordinary house, and the flatness. It should, however, have an inclination of at least six degrees, and should be laid on boards close together; it is also necessary, to give it, annually, a coat of *paint-oil;* 2 or 3 gallons is sufficient, for a house of a common size. Mr. Denison says, the only fear he has, is, that some careless persons, who may use it, may not attend to the directions, and if it should not last, that they would impute to the article, what they should charge to their own neglect.

The proprietor of the Warren Factory, 14 miles from Baltimore, has lately roofed a building, 70 feet long, with it. Part of the New City Hotel building here, is to be covered in like manner."

The above extract reminds the Editor of a fact, which came to his knowledge many years since. A store keeper, living in Second, near

Arch street, purchased from an importer of English floor cloth, a yard or two of that article, with which he proposed to stop a leak in the roof of his house, which he had repeatedly attempted to repair, without success. Four or five years after the application of the floor-cloth, it continued to answer the intended purpose, not a drop of water having found its way through.

The Editor has taken means to obtain further information on the subject of the patent roofing.

The following queries and suggestions, are extracted from letters recently received by a gentleman of this city, from his correspondent, an individual of great intelligence, practically engaged in rural affairs, and who has introduced some valuable improvements in the economic arts.

On preserving Fruit Trees from frost.

"There is an article in the last 'American Farmer,' on the subject of preserving fruit trees from frost. It is there asserted, that if a fruit tree be *enveloped* with straw, or hempen ropes, and the lower ends of the rope be put into a tub of water, that the trees will not be injured by the frost. I should like to ascertain the *truth* of the experiment, before I reasoned on it. I wish you could get the editor of the Franklin Journal to interest himself in this thing; it might produce a discussion of the subject, which might be very beneficial, as it is one of great importance. My own trees, should they remain untouched by late frosts, will, this year, produce me upwards of two thousand dollars, although they are yet young.

"I am preparing to make small *bon-fires*, as I think that smoke will be an effectual preventive, and am determined to try it. It however will be very troublesome, to attend as many little mounds of burning tan, as three thousand trees will require. If I am unable to test it upon the whole, I shall, if possible, protect my peach trees."

"Inquire whether pure oxygen gas escapes from burning saltpetre; and if so, what effect would the disengagement of as much as would proceed from the burning of twenty pounds, have upon an area of ten acres?"

"Would the gas from the burning of saltpetre and sulphur, be destructive to the insect tribe, or only dislodge them?"

Remarks by the Editor.—The mode of preserving trees from frost, above suggested, has been frequently tried, and some have declared it to be effectual. Many vague notions, respecting the conducting power of the rope, in relation either to heat or to electricity, have been brought forward to account for the supposed fact; but certainly by those who have little, or no knowledge of the laws which govern these agents, as the rope would, in either case, be a miserable conductor; and even were it a good one, it is not perceived what aid this would give towards explaining the imagined phenomenon. It would require numerous, varied, and well authenticated experiments, to shake the con-

viction of the editor, that the whole is one of those errors, which having been once disseminated, it is very difficult to eradicate.

The efficacy of the proposed bon-fires, is much less problemetical; a slight difference in the exposure of a tree, determines its fate, on a frosty night; and of course, a slight elevation of temperature in its atmosphere, would frequently avert the danger; fires of tan, of turf, or of any smouldering combustible, made to windward, would sometimes answer the purpose; not however from the smoke, but from the heated air, which would accompany it.

With respect to the query on burning saltpetre, we, in the first place remark, that saltpetre will not burn; that it belongs to the class of bodies, denominated incombustible. It contains, it is true, a large quantity of oxygen, which it readily imparts to heated combustibles with which it is in contact: thus, if we throw a portion on burning coals, the combustion will be brilliant and rapid, because the saltpetre supplies the coal with oxygen, more abundantly, than it would obtain it from the air; the product of the combustion, however, will not be altered; carbonic acid, or fixed air, being disengaged, in either case. When oxygen is obtained from saltpetre, the material must be kept from contact with the fuel, by being placed in an earthen or iron vessel; when the salt will be decomposed, the heat disengaging the oxygen, in the gaseous state. Supposing all this to be done, the disengaged gas, would still produce no other effect than that of heated atmospheric air.

Saltpetre and sulphur, burnt together, would be less effectual in destroying insects, than sulphur burnt alone, or mixed up with saw-dust, tan, &c. Sulphur, burnt without saltpetre, is converted into a gas, (sulphurous acid,) which is destructive of animal life, and will kill the insect tribe, if they are completely subjected to its action, as when applied below one of their nests; but when much diluted with atmospheric air, its effects are but partial.

Sulphur, when burnt in contact with saltpetre, receives from it, a full supply of oxygen, and is then converted into sulphuric acid, (oil of vitriol,) which is a dense liquid, not at all calculated to promote the intended effect.

On Springs, (from the same.)

"It has been asserted by *all* philosophers, from Halley, down to the writers of the present day, that water cannot rise above the source whence it originates. This opinion is certainly erroneous, although it receives support from a number of philosophical experiments, which are conclusive so far as they go; these, however, serve only to manifest the effects of gravity; but water may certainly be propelled by other natural causes, besides that of gravitation. We know that certain gases are disengaged in the interior of the earth, either by the decomposition of water, or of other substances, from various causes, into which it is not necessary now to inquire."

"If in boring for water, there be a stream running horizontally or obliquely, in the line of the bored aperture, the instruments will of

course intersect it: if the reservoir which supplies this stream, be situated higher than the spring at the intersected part, the water will rise to the level of the reservoir, in tubes which may be inserted: if, however, the stream flow in a horizontal line from its source, and is consequently on the same level with it, the water instead of ascending in the tubes, will follow the borers in their descent, in accordance with the received theory. But if in boring deeper, we encounter a fissure, through which confined gases are acting with great elastic force, this stream of water may be thereby forced to rise through the bore in spite of its gravitating power. In this way, in many cases, particularly in boring through strata of lime-stone, or chalk, water may ascend to the surface, although the reservoir by which it is supplied, may be 40, 50, or even 100 feet below."

"It may also sometimes happen, that after passing the stream, in the manner before supposed, the borers may proceed until they perforate a stratum of minerals, from which a large quantity of gas will be immediately extricated, and by which the water may, at first, be raised to the surface, with considerable force, yet its flow may not be permanent. This may arise from the disruption of the parts of the mineral upon which the water operates, thus opening for itself a larger space in which it may be deposited, amd from which it may escape, by having a larger surface through which to percolate. The action of the gas, by which it was at first forced upwards, will thus be counteracted, and the flow at the surface will of course cease."

"Many cases might be cited, to prove that the received theory is incorrect, some of which have been too recently published, to admit of the supposition that the inquisitive are ignorant of them. On the top of St. Helena, there is a fresh water spring. On the Azores also, there are many springs, and, from their situation, and their volcanic origin, these islands cannot obtain their water from fountains of greater elevation. There must, therefore, be some internal commotion of the solids and fluids, which causes the water to rise to the surface. How small a portion of the power, which at first heaved up from the bottom of the ocean, the immense masses of which these islands consist, would suffice to force the water to rise through their numerous fissures, to the surface of the ground! It is admitted that gases and elastic vapours may have been disengaged in such quantities as to raise mountains, and yet the position is disputed, that a lesser portion of the same force, may cause a small stream of water to ascend to a level higher than its source.

"The philosophy of the schools is so prevalent, and all those imbued with its doctrines, subscribe so unhesitatingly to its dictates, that but one opinion can be elicited from them. I fear, therefore, that but little attention will be bestowed on the above remarks. I confess, I am of opinion, that water may be made to flow above the surface in every situation; in some places, we might have to bore to a very great depth, before the proper stratum would be reached, but this does not effect the correctness of the assumption. I am assured that in boring, gases are more frequently met with, than is generally supposed; and that their agency is sufficient to produce the effects which I have ascribed to them."

Query.—" Would it not be well for Dr. Jones to give, in each number of his Journal, a few lines of explanatory terms, as those persons for whom it is principally intended, although sensible and clear minded people, are generally unacquainted with the nomenclature of science, and have neither the time nor the opportunity to search elsewhere for explanations? In reading the article by B. Bevan, to an ingenious mechanic, he stopped me several times, to ask the meaning of such words as *outcrop*, &c. Perhaps it might not be requisite to explain more than dozen words in a whole number; but without this explanation, many articles may not be understood, which, with it, might prove both interesting, and useful."

Remarks.—Although the Editor believes the received theory on the subject of springs, to be true, and therefore, cannot subscribe to the opinion, that water may be made to rise to the surface, in every situation, he willingly assigns a place to the foregoing observations.—Under the circumstances supposed, a lighter, cannot force up a heavier fluid; the gas, of whatever kind it might be, would rise through the shaft, and allow the water to descend; if rapidly disengaged, it would blow up a portion of the water, but would not raise it alone. Under peculiar circumstances, water may ascend, and springs may exist, in situations above the level of any reservoir; it may undoubtedly be evaporated by subterraneous fires; this vapour, may be condensed in elevated situations, and then flow out in the form of a spring; such, in other places, may be the peculiar nature of the soil, that water may be raised to some height, by capillary attraction and we could imagine that a spring might thus be supplied. But these would only form exceptions to a general law, from the existence of circumstances, of rare occurrence.

The suggestion respecting terms of science, merits, and shall receive, attention. To render science, subservient to the arts, is a main object of this work; the aims of the Editor are high, but the novelty of the undertaking, and the many arrangements which he has had to make, have, in some measure, prevented the full accomplishment of his views. In the attempt, he has been gratified by the approbation of the intelligent; and he is determined to increase his claims to this valued reward of his labours.

COMPOUNDS OF METALS.

FROM NICHOLSON'S OPERATIVE MECHANIC.

(*Continued from page* 124.)

Gun Metal, No. 1.—16 parts of good brass,
2 parts of zinc, and
1 part of block-tin.

No. 2.—9 parts of copper, and
1 part of tin.

The above compounds are those used in the manufacture of small and great brass guns, swivels, &c.

Blanched Copper.—16 parts of copper, and
1 part of neutral arsenical salt,
fused together, under a flux compound of calcined borax, charcoal dust, and fine powder glass.

Specula of Telescopes.—7 parts of copper, and when fused, add
3 parts of zinc, and
4 parts of tin.

These metals will combine, and form a beautiful alloy of great lustre, and of a light yellow colour, fitted to be made into specula, for telescopes. Mr. Mudge used only copper and grain tin, in the proportion of two pounds, to fourteen and a half ounces.

Kerstitien's Metal, for tinning.

To 1 part of malleable iron, at a white heat, add
$\frac{1}{3}$ of a part of regulus of antimony, and
24 parts of the purest Molucca tin.

This alloy polishes without the blue tint, and is free from lead or arsenic.

Metal, for Flute-key Valves.

4 parts of lead, and
2 parts of antimony,
fused in a crucible, and cast into a bar, form an alloy of considerable hardness and lustre. It is used by flute manufacturers, (when turned into small buttons in the lathe,) for making valves to stop the key-holes of flutes.

Printers' Types.—5 parts of lead, and
1 part of antimony.

The antimony must be thrown into the crucible, when the lead is in a state of fusion. The antimony gives a hardness to the lead, without which, the type would speedily be rendered useless in a printing press. Different proportions of lead, copper, brass, and antimony, frequently constitute this metal. Every artist has his own proportions, so that the same composition cannot be obtained from different founderies; each boasts of the superiority of his own mixture.

Small Types and Stereotype Plates, No. 1.

9 parts of lead, and when melted, add
2 parts of antimony, and
1 part of bismuth.

This alloy expands as it cools, and is, therefore, well suited for the formation of small printing types, (particularly when many are cast together, to form stereotype plates,) as the whole of the mould is accurately filled with the alloy; consequently there can be no blemish in the letters.

No. 2.—8 parts lead,
2 parts antimony, and
$\frac{1}{3}$ part tin.

For the manufacture of stereotype plates, plaster of Paris, of the consistence of batter-pudding before baking, is poured over the letter-press page, and worked into the interstices of the types with a brush. It is then collected from the sides by a slip of iron or wood, so as to lie smooth and compact. In about two minutes the whole mass is hardened into a solid cake, this cake, which is to serve as the matrix of the stereotype plate, is now put upon a rack in an oven, where it undergoes considerable heat, so as to drive off superfluous moisture. When ready for use, these moulds, according to their size, are placed in flat cast-iron pots, and are covered over with another piece of cast-iron, perforated at each end, to admit the metallic composition intended for the preparation of the stereotype plates. The flat cast-iron pots, are now fastened in a crane, which carries them steadily to the metallic bath, or melting-pot, where they are immersed, and kept for a considerable time, until all the pores and crevices of the mould are completely and accurately filled. When this has taken place, the pots are elevated from the bath by working the crane, and are placed over a water-trough to cool gradually. When cold, the whole is turned out of the pots, and the plaster being separated by hammering and washing, the plates are ready for use, having received the most exact and perfect impression.

Metallic Casts from Engravings on Copper.

A most important discovery has lately been made, which promises to be of considerable utility in the fine arts: some very beautiful specimens of metallic plates, of a peculiar composition, have lately appeared, under the name of "cast engravings." This invention consists in taking moulds from every kind of engravings; with line, mezzitinto, or aquatinta; and pouring on these moulds, an alloy, in a state of fusion, capable of taking the finest impressions. The obvious utility of this invention, as applicable to engravings which meet with a ready sale, and of which great numbers are required, will be incalculable; as it will wholly prevent the expense of retracing, which forms so prominent a charge, in all works of an extended sale. No sooner is one cast worn out, than another may be immediately procured from the original plate, so that every impression will be a proof. Thus the works of our most celebrated artists, may be handed down, *ad infinitum*, for the improvement and delight of future ages, and will afford, at the same time, the greatest satisfaction to every lover of the fine arts.

Common Pewter.—56 parts of tin,
8 parts of lead,
3 parts of copper, and
1 part of zinc.

The copper must be fused, before the other ingredients are added. This combination of metals, will form an alloy of great durability and tenacity; also, of considerable lustre.

Best Pewter.—100 parts of tin, and
17 parts of regulus of antimony.

Hard Pewter.—12 parts of tin,
1 part of regulus of antimony, and
$\frac{1}{4}$ part of copper.

Common Solder.—2 parts of lead, and
1 part of tin.

The lead must be melted, before the tin is added. This alloy, when heated by a hot iron, and applied to the tinned iron, with powdered rosin, acts as a cement, or solder; it is also used to join lead pipes, &c.

Soft Solder.—2 parts of tin, and
1 part of lead.

Solder for Steel Joints.—19 parts of fine silver,
1 part of copper, and
2 parts of brass,

melted together under a coat of charcoal dust. This solder possesses several advantages over the usual zinc solder, or brass, when employed in soldering cast steel, &c. as it fuses with less heat, and its whiteness has a better appearance than brass.

Silver Solder for Jewellers.
19 parts of fine silver,
1 part of copper, and
10 parts of brass.

Silver Solder for Plating.
1 part of brass, and
2 parts of pure silver.

Gold solder.—6 parts of pure gold,
1 part of pure silver, and
2 parts of copper.

Brass solder for Iron.—Thin plates of brass are to be melted between the pieces that are to be joined. If the work be very fine, as when two leaves of a broken saw, are to be brazed together, cover it with pulverized borax, moistened with water, that it may incorporate with the brass powder, which is added to it: the piece must be then exposed to the fire, without touching the coals, and heated till the brass is seen to run.

Bronze.—7 parts of pure copper,
3 parts of zinc, and
2 parts of tin.

The copper must be fused, before the other ingredients are added. These metals, when combined, form the bronze so much used, both in ancient and modern times, in the formation of busts, medals, and statues.

Composition of ancient Statues.

According to Pliny, the metal used by the Romans, for their statues, and for the plates on which they engraved inscriptions, was composed in the following manner. They first melted a quantity of copper, into which, they put $\frac{1}{3}$ of its weight of old copper, which had

been long in use; to every 100lbs. weight of this mixture, they added 12½lbs. of an alloy composed of equal parts of lead and tin.

Mock Platinum.—Melt together,
8 parts of brass, and
5 parts of zinc.

Useful alloy of Gold with Platinum.
15 parts of pure gold, and
1 part of platinum.

The platinum must be added, when the gold is perfectly melted. The two metals will combine intimately, forming an alloy, rather whiter than pure gold, but remarkably ductile, and elastic; it is also, less perishable than pure gold, or jewellers' gold; but more readily fusible than that metal.

These excellent qualities, must render this alloy an object of great interest to workers in metals. For *springs*, where steel cannot be used, it will prove exceedingly advantageous.

It is a curious circumstance, that the alloy of gold and platinum, is soluble in nitric acid, which does not act on either of the metals in a separate state. It is remarkable, too, that the alloy has very nearly the colour of platinum, even when composed of eleven parts of gold, to one, of the former metal.

Ring Gold.—6 dwts. 12 grs. Spanish copper,
3 dwts. 16 grs. fine silver, and
1 oz. 5 dwts. gold coin.

Gold, 35s. to 40s. sterling, per ounce.
8 dwts. 8 grs. Spanish copper,
10 dwts. fine silver, and
1 oz. gold coin.

Manheim Gold, or Similor.
3½ oz. of copper,
1½ oz. of brass, and
15 grs. pure tin.

Metal to gild on.—4 parts of copper,
1 part of Bristol old brass, and
14 oz. of tin, to every pound of copper.

For common Jewellery.—3 parts of copper,
1 part of Bristol old brass, and
4 oz. of tin, to every pound of copper.

If this alloy is for fine polishing, the tin may be omitted, and a mixture of lead, and antimony, substituted. Paler polishing metal is made, by reducing the copper to two, or to one part.

Yellow Dipping Metal.—No. 1.
2 parts of Cheadle brass,
1 part of copper, with a little
Bristol old brass, and
¼ oz. of tin, to every pound of copper.

This alloy is almost of the colour of gold coin. Cheadle brass is the darkest, and gives the metal a greenish hue. Old Bristol brass, is pale, and yellow.

No. 2.—16 parts of copper, and
5 parts of zinc.

The copper should be tough cake, and not tile.

When antimony is used instead of tin, it should be in smaller quantity, or the metal will be brittle.

Imitation of Silver.—$\frac{3}{4}$ oz. of tin, and
1 lb. of copper,
will make a pale bell metal, which will roll, and ring, very nearly equal to sterling silver.

On a new mode of Embossing Designs on Wood. By Mr. John Straker.

Raised figures on wood, such as are employed in picture-frames, and other articles of ornamental cabinet-work, are produced by means of carving, or by casting the pattern in Paris-plaster or other composition, and cementing, or otherwise fixing it on the surface of the wood. The former mode is expensive; the latter is inapplicable on many occasions.

The invention of Mr. Straker may be used either by itself, or in aid of carving; and depends on the fact, that if a depression be made by a blunt instrument on the surface of wood, such depressed part will again rise to its original level by subsequent immersion in water.

The wood to be ornamented, having first been worked out to its proposed shape, is in a state to receive the drawing of the pattern; this being put in, a steel-punch, or die, properly formed, is to be applied successively to all those parts of the pattern intended to be in relief, and at the same time is to be driven very cautiously, without breaking the grain of the wood, till the depth of the depression is equal to the subsequent prominence of the figures. The ground is then to be reduced, by planing or filing, to the level of the depressed part; after which, the piece of wood being placed in water, either hot or cold, the parts previously depressed will rise to their former height, and will thus form an embossed pattern, which may be finished by the usual operations of carving.

Remarks by the Editor.

The above is from the Transactions of the Society, in London, for the Encouragement of Arts, Manufactures, and Commerce; who voted a silver medal, and ten guineas, to Mr. Straker, for his invention. The Editor, when a boy, possessed an old book, in which the above process was detailed as fully as in the article before us. This book must have been published at least eighty years ago; the kinds of wood, most suitable for the process, were mentioned, and some arti-

cles particularized, to which it might be applied. So much for originality. With regard to its utility, we observe, that the texture of the wood will be greatly weakened; for ornamental gilding, this is unimportant; but when the projecting parts are to be subjected to any degree of force, as in a walking stick, they would be readily broken, as they have been already bruised in the punching down.

Extract of a Letter, on Tanning, from JOHN BURRIDGE, *to the Editor of the London Journal of Arts.*

"SIR—History and experience prove, that men are frequently more indebted to accident than design, for many of the most useful discoveries and improvements; which are, moreover, often accomplished by the simplest means—the compass, for instance.

"I have discovered the means of ascertaining the relative degrees of strength in oak bark liquors; I have also discovered that the simple and regular application of oak-bark liquors, &c. to hides, will effectually tan sole leather in three or four months, (according to their thicknesses,) provided you commence at three degrees, and gradually increase the strength of the liquor, thrice a week, up to fifteen or twenty degrees, taking care not to apply strong liquors, till the leather is nearly tanned.

"There can be no theory prescribed as to the exact time when the hides may be forced with advantage; practice only can master in this nice point; the simple instrument I use, is an hydrometer, which I have surnamed a BARKOMETER; without which, I should be more in the dark, than brewers without saccharometers or thermometers.

"I have also found means, by the constant use of pumps, to extract all the virtue from oak-bark in ten days, which generally lies in common tan-yards two or three months. My hydrometer proves I throw no tannin away.

"The execution of this process, with daily care, produces additional weight in leather over the standard. Tanners generally require twelve months to tan hides, that may by my system be done in three months, with perfect ease. Common tanners are satisfied if a hide of eighty pounds, when raw, yield forty pounds, when tanned. Whereas, my process will produce forty-eight pounds of leather from similar hides, which is actually one-fifth more leather in a quarter of the usual time. Is this not a plain proof, that hides lay rotting, rather than tanning, after four months? because weight is the criterion of the quality of leather, and the least weight is the fruit of the longest time.

"Many tanners immerse crop hides in bark, for two or three months, during which single stage, I tan the stoutest hides in the kingdom, without more than the usual quantity of bark, because it is generally acknowledged, that four or five pounds of oak-bark, (according to its quality,) will tan one pound of leather."

TANNING LEATHER IN COLD WEATHER.

Have an iron kettle, or boiler, for the purpose of containing water, with a wooden lid or cover; a wooden penstock let into the boiler through the lid or cover, and extending upwards; in one side of the penstock, towards the upper end, is a hole made by an augur, into which enters a common conductor of wood or other materials. The other end of which conductor, passes over the tan vats—the steam arising from the boiler, which is fixed in an arch, ascends the penstock, and from thence passes into the conductor over the vats; one or more wooden conductors to each vat, to be let into the main conductor, and penetrate downward into the vat, which is open at the lower end, will enable persons to tan leather, in cold climates, in the winter season as well as in summer.

EXTRACTS FROM BARK.

That which is designed for the use of tanners, is found to be most highly improved, by adding to every hundred weight of the ground bark, eight pounds of red berry, which grows upon sumack; the advantages therefrom are hardly conceivable, as in the first place it opens the nature of the bark, and causes a much quicker precipitation of the light woody matter, when settling for evaporation. It also holds in a complete dissolved state, every particle of resinous matter contained therein, and supplies the great loss of vegetable acid, so necessary in tanning, and which evidently escapes during the evaporation. The good effects of this addition in regard to tanning, is quickly to be observed from its immediate action on the leather, to which it imparts a fine colour, and fills it in the completest manner.

PREPARING QUILLS.

M. Scholz, of Vienna, has discovered a new process for rendering quills more firm and durable than those of Hamburg. The following are the means employed:—He suspends, in a copper, a certain number of quills, and fills it with water, so as just to touch their nibs. He then closes the copper, so as to render it steam tight; here the quills experience considerable heat and moisture from the steam, by which the fat they contain is melted out. After about four hours' treatment in this manner, they attain the proper degree of softness and transparency. The next day cut the nibs, and draw out the pith, then rub them with a piece of cloth, and also expose them to a moderate heat. The following day they will have acquired the hardness of bone without being brittle, and will be as transparent as glass.

IMPROVEMENT IN THE LIME KILN.

This kiln is made of either earth, brick, or stone, and formed in the following described manner:—

One end of said kiln is built of a square form, having four sides of about eight feet wide each, and ten feet in height.

At the bottom of said square part are three furnaces, or arches, with divisions between them, similar to those in the arches of a brick kiln; these arches extend in depth the same as that of the square part before mentioned, the part over the arches is then filled up, and made level to form the floor of said square part; in the centre of one of the four sides of said square part, there is a door, either at the height of the floor, or higher up.

From one, two, or all the four sides of said square parts, projects an arch, or vault, of a semi-circular form, and about six feet in height: said arch, or vault, extends out about 26 feet, and is formed bevelling towards the extreme end.

At the bottom of the end of said vault there are three furnaces, or arches, in every respect similar to the arches in the square part before described: over each of said arches, at the height of the level floor there are three openings for the purpose of introducing the wood to supply the fire at the back part of the arch or vault.

The lime is taken in from the door in the square part; and laid on the floor of the arch or vault, which is on a level with the bottom of the furnaces or arches before mentioned, the lime-stone is so placed as to form a continuation of the arches at the ends of the kiln. The upper part of the vault or arch is then filled in a compact manner, leaving a vacuum or space between the wall of the narrow end of the vault, and the lime-stone; which vacuum contains the fire that is made on the level part over the under arches.

When the lime-stone is all stowed, the mouth or opening in the widest end of the vault or vaults is then bricked up with loose bricks, the arches filled with wood, and fire set to it, and let burn until the lime-stone is turned to lime. [*London Journal.*

TO CONVERT IRON INTO STEEL.

It is well known to all persons conversant with the art of converting iron into steel, that the pulverized charcoal or carbon, together with whatever other substance they may mix with it, if any, is laid into the furnace in layers, between each layer or strata of iron. 1st. *To make one side of common flat bars of iron into steel, but half through each bar.* Let there be first, a layer of carbon in the common way; then a layer of bars of iron; then a layer of clay, or mixture of clay, that will not melt with the necessary heat to be applied, or any other substance not containing carbon sufficient to convert iron into steel, and that has no tendency to damage the purity of iron. The next layer of iron to be laid upon this clay or other substance, and then again

carbon, and so through the batch alternately, a layer of carbon, and a layer of other substance, between the layers of iron. Being thus laid, and heated a sufficient length of time, and to a proper degree of heat, to convert the bars of iron thoroughly into steel, when laid in the common way, will of course leave these bars half iron.

If it be wished, to make the bars more than half steel, it will be seen at once, that it must be kept hot a suitable time longer; and if less, then half a suitable time shorter. If one edge of flat bars are to be converted to steel, the same principle is to be followed, by setting the bars edgewise in the furnace, and letting the carbon come in contact with the iron, on both sides of the bar; so far as it is wished, it may be converted to steel, applying the clay or other substance to the part to be left, iron; and in whatever shape the iron may be it is immaterial, so that the carbon come in contact with the part to be made into steel, and not elsewhere.

This operation may also be performed without any clay, or any other substance being applied to the parts to be left, iron. The application of clay, &c. is much preferable, as by it there is a more complete command over the parts not to be converted into steel.

METEORIC IRON.

M. Humboldt presented to the Royal Academy of Sciences, at Paris, a fragment of a mass of meteoric iron, which was found in Colombia, at a short distance from Santa Fé de Bogota, near the summit of a mountain. The entire mass weighed 3300 pounds, and required great labour to remove it to the forge of a smith, who bought it for about five pounds, and who began by smelting a part of it, with the intention of employing it for the uses of his trade. Having, however, found it too brittle for his purpose, he gave up the idea of working it, and even concealed the remainder of it, through a fear lest his credit should be injured if it were known he employed such an inferior article. Fortunately, an eminent naturalist, M. Humboldt's correspondent, having accidentally learnt the secret, obtained the mass of iron, and analysed a part of it. The result of this analysis, by proving the existence of a certain quantity of nickel, mingled with the ore, has put the aërial origin of this mass, beyond a doubt. The aërolite of which M. Humboldt has presented a fragment to the Academy, is one of the most curious, mentioned in the history of *science.*

A Process to render Cloth, and Silk, water-proof. By M. Collet.

The cloth, or silk, must be spread upon a wooden frame, and immersed, or soaked, with the following mixture: linseed oil, one pound, white lead, one ounce and a half; umber, one ounce, and a clove of garlic. The whole of these ingredients must boil for twelve hours on a small

fire; and when the composition is perfectly fit for use, the surface will put on the appearance of skin.

The cloth, after having been immersed in, or washed, with this composition, is to be hung up to dry, and when that is effected, to be rubbed with pumice stone, to render it smooth. It is then to be coated with another thick fluid, composed of linseed oil, one pound; vitrious oxide of lead, one ounce; sulphate of zinc, four drachms; and white lead, calcined till it has changed yellow, four ounces. These must be previously boiled together in an iron pot, until the material have the consistence of paste; the composition is then to be spread equally over the right side of the cloth; the material is then dried upon the fabric in a chamber, heated to forty or fifty degrees; it is necessary to repeat the operation twice for silk, and the result will be the production of an oil skin cloth, which will be water-proof, and not rub nor wash off.

LOCOMOTIVE CARRIAGES.

A new line of railway has just been completed, leading from the colleries, in the neighbourhood of Darlington, to Stockton upon Tees, in the county of Durham, (formed under the direction of Mr. Stevenson, the engineer, of Newcastle.) The wagons are drawn upon plain rails, with curved tops, (Birkinshaws, see vol. ii.) by locomotive steam engines. The construction of these engines, is not different in principle, from those employed upon the Hetton line of railway, near Sunderland; but they exert their power with better effect, and move faster.

The medium speed of the engines and carriages, upon the level parts of the new line, is about six miles per hour; while the speed upon the level of the Hetton line, seldom exceeds three miles and a half, per hour. This improvement is to be attributed to the increased size of the boiler, and to the employment of larger running wheels.

The weight of the locomotive engine, is about seven tons; having a cylindrical boiler, ten feet long, and four feet diameter, coated with wood, to prevent the radiation of heat, and placed in a horizontal position, with the fire inside the cylinder, and the flue two feet diameter, leading straight through the boiler, to the chimney. There are two working pistons moving perpendicularly, in cylinders of nine and a half inches, diameter; which cylinders are principally immersed in the boiler, and the pistons are packed with hemp.

The steam acts at a pressure of thirty pounds, upon every square inch of the boiler; and the safety valve, is loaded to the extent of fifty pounds. The induction and eduction valves of both cylinders, are worked by rods connected to excentrics below, and the alternating power of the pistons, is communicated by parallel motions, and sweep rods on each side, to cranks upon the spokes of the running wheels; the direction of these, cranks upon the fore and hind wheels, being at a quarter of a circle removed, in order to overcome the dead points of the strokes of the pistons, and consequently the range of the cranks

are two feet. The running wheels being four feet diameter, with flanges on their edges.

The water is supplied to the boiler, by pipes leading from a cistern carried in a cart, and attached behind the engine; the same cart also carries the coals for feeding the furnace, which consumes about three quarters of a ton, in going a distance of fifty miles.

Certain parts of the line of road, rise half an inch in a yard; this the power of the engine overcomes readily, with twenty carriages attached to it, each containing about two tons weight, and proceeds as above said, upon an average, at the rate of six miles per hour. On the first day of opening the rail-way, a train of thirty loaded wagons, and a carriage with passengers, was drawn along some part of the line, at the rate of fifteen miles per hour; but this was doubtless a mere experiment; the ordinary speed, is not likely to exceed six miles, as above stated: but this speed, and the employment of a plain rail, is certainly a considerable improvement upon the locomotive carriages, near Leeds, which travel upon a rack or cogged rail, and not faster than two and a half, or three miles, per hour.

New mode of preparing Paper, for the use of Draughtsmen, &c. By MR. COUDER.

Reduce to a powder, and dissolve quickly in a glazed earthen vessel, containing cold water, some gum adragant, having been well worked with a wooden spatula, to free it from lumps. There must be a sufficient quantity of water, to give to this diluted gum, the consistence of a jelly. Paper, and some sorts of stuffs, upon which, if this composition be smoothly applied, with a pencil, or a brush, and dried before a gentle fire, will receive either water or oil colours; in using water colours, they must be mixed with a solution of the above gum. This cloth or paper, so prepared, will take any colour except ink. When it is intended to retouch any particular part of the drawing, it should be washed with a sponge, or clean linen, or a pencil, (containing some of the above-mentioned liquid;) if the part is only small, it will then rise quickly, and appear as if repainted.

A Composition to render Wood fire-proof. By DR. FUCHS.

Dr. Fuchs, member of the Academy of Science, at Munich, is said to have discovered a composition, by which he renders wood, incombustible; the composition is made of granulated earth, and an alkali. To obtain this composition, the inventor says, you must dissolve some moist, gravelly earth, which has been previously well washed, and cleared from any heterogeneous matter, in a solution of caustic alkali. This mixture has the property of not becoming decomposed by fire or water. When spread upon wood, it forms a vitrious coat, and is proof against the two elements. The building committee of the royal theatre, have twice publicly tried the efficacy of the composition

on two small buildings, of six or eight feet in length, and of a proportionate height; the one was covered with the composition, and the other built in the usual manner. The fire was put equally in the two buildings; the one which was not covered with the composition, was consumed, whilst the other remained perfect, and entire. The cost of this process, is very insignificant, compared to its great utility, being about two francs three centimes per 100 square feet.

The royal theatre at Munich has undergone this process, having about 400,000 square feet; the expense of which was about 4 or 5000 francs.

The late Earl Stanhope made some very successful experiments upon this subject; he coated a building with sand and glue, which proved perfectly fire-proof.

ON CHRONOMETERS.

In the United States Gazette of the 8th inst. is a statement taken from Snowden's New York Advocate, of what is denominated "a curious discovery" upon the variation of chronometers. It appears that Mr. Harvey, of London, by repeated experiments. has ascertained that the density of the medium in which a chronometer is placed, has a sensible influence upon its rate; in other words, that a chronometer constructed in London, which is nearly on a level with the sea, would undergo an alteration of rate from a difference of atmospheric pressure alone, if transported to Madrid, Mexico, or any other place, much above the level of the place where it was constructed.

The cause will be found in the balance. All chronometers that are adjusted by screws, will vary in their time, according to the experiments of Mr. Harvey. These screws having large heads, one on each side of the balance, their line crossing the centre, and the loadings, the line of which crosses that of the screws at right angles, make *four projections*, from the rim; these, in consequence of its velocity, strike the atmosphere with great relative force. The effect produced is, that in a more elevated situation, or less dense medium, than that in which the chronometer was adjusted, its motion will be faster, and so the contrary, in a lower or heavier atmosphere.

A chronometer drops from 125 to 150 times in one minute, according to the calculation of the train; and a free, accurately made scapement, with a force of main-spring in proper accordance with the weight of the balance, will always give that balance, an entire revolution, at least, to every drop. The subscriber, at this time, has one made by Bissett, Royal Exchange, that throws its balance a revolution and a third, which gives it an action equal to two hundred complete circles, in one minute. When it is considered that the loadings of this balance, present a flat, and the screws, for adjustment, a round projecting surface to the atmosphere, and that all are upon its periphery, thrown back and forth, at the above rate, it will be readily perceived, that different densities will, in some degree, affect the action, and consequently the time of the chronometer. In

order to avoid such variation, it will be found necessary to abandon the loading, and the screws at present used for bringing chronometers to adjustment. Even the *arms* of an ordinary balance ought to be considered as an objection, where there is so much accuracy required, as in a navigating time-keeper. Suppose the balance to be turned out of a solid piece of metal, and instead of being crossed out into arms, turned down very thin, and left unbroken, between the rim, and centre: when perfectly true upon its pivots, its active motion will not create the least atmospheric resistance.

It will doubtless be said, that to give up the spiral spring, and the compensating balance in segments, would be sacrificing too much, to avoid the disadvantages of the surrounding medium. But let it be recollected, that the compensating balance, when it does act, is more apt to derange, than to regulate, the time. The subscriber, in one instance, knew a very expensive chronometer, with the compensating balance in segments, to lose from its usual rate, ten seconds in six hours, when exposed to a temperature of *five* degrees below the freezing point; when, by another time keeper, the effect of the frost upon the hair, or pendulum spring, was found to produce, at the same exposure, a *gain* of only two seconds; consequently, its *balance*, produced a variation of eight seconds. The writer has frequently observed, in adjusting a chronometer, and also duplex watches with chronometer balances, that when the cut in the screw-heads was brought nearly to a line with the motion, that by turning the screws outwards, until their cut was precisely parallel with the action, instead of losing, they would gain, upon their rates; evidently, because the atmosphere was struck by a smaller body.

Time-keepers might even be *regulated*, with some degree of accuracy, by *atmospheric resistance alone*. Suppose two thin pieces of metal, were attached to each side of the balance, in such a way as to be moved round, in order to present their *edges* to the motion; the *quickest* action would then be produced, and the *slowest* when the *sides* were carried against the opposing medium. The changes necessary to find the time, could be brought about, by turning the edges to the different degrees, from a horizontal to a vertical position. The atmosphere operating thus powerfully, the result of the ingenious Mr. Harvey's experiments upon its different densities, may reasonably be considered a settled fact. That it is altogether the *balance* of the chronometer which is affected, seems no less an undoubting conclusion.

BENJAMIN F. BAKER.

Philadelphia, March 28, 1826.

Proposed Polytechnic and Scientific College, in Philadelphia.

A public meeting of the citizens of Philadelphia, was called on the 4th of this month, at the instance of Peter A. Browne, Esq.; to take into consideration the propriety of establishing a college in this city, where English literature, the sciences, and the liberal arts, might be taught, without requiring for admission, an acquaintance with the La-

tin and Greek languages; and where the price charged for tuition should be such, as to place within the power of the industrious mechanic, the opportunity of giving to his sons, a scientific education.

At this meeting, General Thomas Cadwalader presided; and Mark Richards, Esq. was appointed secretary. After some discussion on the merits of the question, it was, by an unanimous vote, determined, that it was expedient to establish such a college; and a committee, of eleven gentlemen, was appointed, "to digest, and report a plan" for the proposed institution. On the 25th instant, another meeting was called, when Mr. Browne, the chairman of the committee, presented a report, of which the following is an abstract.

The committee recommend, that in the College, to be established, instruction be given in every branch of knowledge requisite "for the agriculturist, the mechanic, or manufacturer; the architect, the civil-engineer, the merchant, and other man of business." The branches enumerated in the report, are: vulgar and decimal arithmetic, grammar, belles-lettres, geography, history, chronology, the mathematics, natural philosophy, including mechanics and astronomy; chemistry, mineralogy, political economy and the general principles of government and jurisprudence; the modern languages, particularly the German, French, and Spanish. They recommend that the Latin and Greek languages, should also be taught, to those who can afford the time and expense, and wish to learn them; and that, in teaching the different branches of science, particular attention be paid to their application to the useful arts.

These are mentioned as the prominent branches of instruction, whilst others, not incompatible with the general plan, may hereafter be added; those which are merely ornamental, it is observed, should be excluded.

The committee deprecate the idea of superficial instruction in any department; and earnestly recommend, that whatever is taught in the College, be taught in the best manner; pains should be taken to impress upon the pupils the necessity of a thorough knowledge of the various branches which they undertake to acquire. Rolls of merit ought to be rigidly kept; and it should be a rule, inflexibly observed, that the honours of the institution shall never be conferred, except on those who really merit them, by their conduct, and attainments.

The remainder of the report, is dedicated to the expense of tuition, the number of pupils, the funds, and the manner in which the College shall be governed.

It is presumed, that the income, arising from tuition, will be equal to the ordinary disbursements. That a fund may be raised among our fellow citizens, by an annual subscription of two dollars; which, whilst continued, shall constitute the subscribers patrons of the institution; and by a payment of twenty dollars, or upwards, shall constitute them contributors for life.

It is recommended, that a memorial, asking the aid of the legislature, be laid before that body, at the opening of the next session.

For the government of the College, it is advised, that a board of 18 trustees should be appointed by the meeting, to continue in office

until the first Monday in March, 1827; on which day, and thenceforward annually, a new board shall be elected, by the annual, and life contributors.

The report was unanimously accepted, and the first board of trustees appointed, and empowered to name ward, and township committees, for the purpose of procuring subscriptions.

Considerable interest has been excited, by the proposition to establish an institution, upon the plan above indicated. A great innovation is proposed, in the principle upon which collegiate establishments, have hitherto been founded: it is, therefore, a point upon which a difference of opinion, must necessarily exist.*

The Editor does not deem it proper, to discuss the merits of this question, in a journal devoted principally, to operative mechanics, and the useful arts. He, however, will not dismiss it without remarking, that considerable misconception has been evinced, both by the opposers, and the advocates, of the proposed plan. By the former, it has been represented as unacceptable to those whom it is proposed to benefit, as it is said to be viewed by them, as *aristocratical.* The Editor, and many of his coadjutors, have conversed upon the subject freely and frequently, with persons who might be expected to urge such an objection, if any such existed, without having once encountered it. Some of the friends of the measure, have charged the gentlemen connected with the University, with being particularly hostile to the plan. Several individuals, so situated, have avowed their hostility; but speaking of the University, as a body, the charge is certainly unfounded, and like most other sweeping declarations, it is unfortunate that it should have been made, as it is calculated, by its injustice, to excite opposition. Several of the members of that institution, have expressed sentiments, the most friendly, to the plan; considering it as likely to benefit a valuable portion of the community, without producing injury to existing establishments. As a body, the University is to be viewed as altogether unconnected with the measure; as individuals, its members have an undoubted right to act upon their own convictions.

NOTICES.

In our last number we published, the Prospectus of "The Reports of Mr. Strickland." To this work, which is of national importance, we again call the attention of our readers. On the cover of the present number, will be found a list of the copper-plate Engravings, which will accompany it. They are, in number, seventy-two; several of them, will be two, and some three feet, in length.

* It has been said, that a College where the Latin and Greek languages were not considered as fundamental branches, was a thing altogether unknown. This is a mistake: during the time that the Editor held the Professorships of Natural Philosophy, and of Chymistry, in the University of William & Mary, in Virginia, as well as for several years prior and subsequent to that period, the ancient languages were not taught, and the honours of the institution were given, for proficiency in English literature, and the sciences.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Dear Sir—In the first number of your Journal, I published a note, stating some reasons why the book, called "Fauna Americana," should not have received notice as an *original* work, stating that it is very little better than a mere *literal*, though *unacknowledged* translation from Desmarest, with the exception of "the description of about *fifty species*."

In a few days, I shall publish a letter, which, from its length, and the subject it treats of, I could not expect you to insert in the Journal. In that letter, it is my intention to state, in detail, the facts, relative to this plagiarism; and to show, that in an attempt to refute the charge made in your first number, the author of the "Fauna," has not fairly met the question before the public.

I am, with respect, your friend and servant,

JOHN D. GODMAN.

P. S. As soon as the above letter is published, a copy of the "Fauna," with references, together with the original work of Desmarest, will be placed in some public situation for inpection and comparison.

[In the contest, to which the above alludes, the Editor wishes not to be considered as a partisan; although the discussion is not suited to his columns, they are open, to an equal extent, to either of the gentlemen concerned.]

TO SUBSCRIBERS AND CORRESPONDENTS.

Semi Doctus, appears to have a theory of his own, upon the subject of *Inertia*; his notices, however, are too brief, to enable others to understand it. If he will develope his ideas more fully, he shall receive that attention, which, from the specimen before us, we think he claims, by his talents.

Our Subscribers will perceive, that the present number appears with a new type; other improvements are contemplated, and shall be carried into effect, with all convenient speed.

A considerable portion of our 4th, or 5th number, will be occupied with a paper, on the subject of fuel, by Marcus Bull, of this city. It will detail a series of experiments, which have been carried on with singular industry, and skill, for upwards of two years. Gentlemen of science, well able to appreciate the merits of the undertaking, have viewed the apparatus employed, the enquiry in its progress, and the results obtained, with unqualified approbation. The memoir will be accompanied by a plate of the apparatus.

An article of equal length, will not, probably, again appear in a single number of the Journal; the Editor, however, is of opinion, that the communication alluded to, will plead its own cause, and require no apology from him.

THE

FRANKLIN JOURNAL,

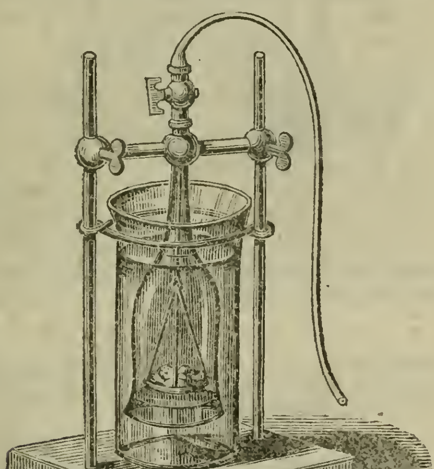
AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE MECHANIC ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

APRIL, 1826.

Self-regulating Reservoir, for Hydrogen and other Gases, as used in the Chemical Laboratory of the University of Pennsylvania, by R. Hare, *M. D. Professor of Chemistry, &c.*



The preceding figure, represents a self-regulating reservoir for hydrogen gas, (whether pure or sulphuretted;) or for nitric oxide, or carbonic acid gas.

This very perspicuous engraving, requires but little to be said in explanation of it. Suppose the glass jar without, to contain diluted sulphuric acid; the inverted bell, within the jar, to contain some zinc.

supported on a tray of copper, suspended by wires, of the same metal, from the neck of the bell. The cock being open, when the bell is lowered into the position in which it is represented, the atmospheric air will escape, and the acid, entering the cavity of the bell, will, by its reaction with the zinc, cause hydrogen gas to be evolved rapidly. As soon as the cock is closed, the hydrogen expels the acid from the cavity of the bell ; and consequently, its reaction with the zinc is prevented, until there be reason for drawing off another portion of the gas. As soon as this is done, the acid re-enters the cavity of the bell, and the evolution of hydrogen is renewed, and continued until again arrested, as in the first instance, by preventing its escape, and consequently causing it to displace the acid from the interior of the bell, within which, the zinc is suspended.

This apparatus, in the same form as here represented, answers perfectly well. as a self-regulating reservoirof sulphuretted hydrogen ; using sulphuret of iron instead of zinc. With pieces of marble and muriatic acid, it answers equally well for carbonic acid gas. To qualify it for nitric acid gas, in lieu of the copper tray and wires, a coil of copper may be suspended, by a platina wire, or by a glass tube having an enlargement, at the lower end, like a nail head.

The principle, of this apparatus, is analogous to that which was contrived by Gay Lussac. I had employed the same principle, however, when at Williamsburgh, to moderate the evolution of carbonic acid, before I had read of Gay Lussac's apparatus.

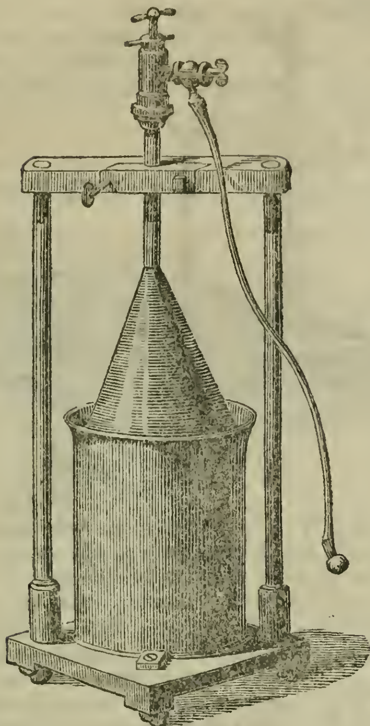
I prefer the modification, above described. In the first place, it is internally more easy of access, for the purpose of cleansing: secondly, it is much better qualified for containing sulphuret of iron, or marble, for generating sulphuretted hydrogen, or carbonic acid gas ; and thirdly, by raising the bell glass, the pressure may be removed.

In the other form, the pressure on the gas is so great, that, unless the tube, the cock, and their junctures, be perfectly tight, there must be a considerable loss of materials; since the escape of gas, inevitably causes their consumption, by permitting the acid to reach the zinc, or other materials, employed.

Large Self-Regulating Reservoir, for Hydrogen, as used in the Laboratory of the University of Pennsylvania, by R. Hare, M. D.

The figure, (at the top of the next page,) represents a self-regulating reservoir, for hydrogen gas; it is constructed like that described in the preceding article, excepting, that it is about 50 times larger, and is made of lead, instead of glass.

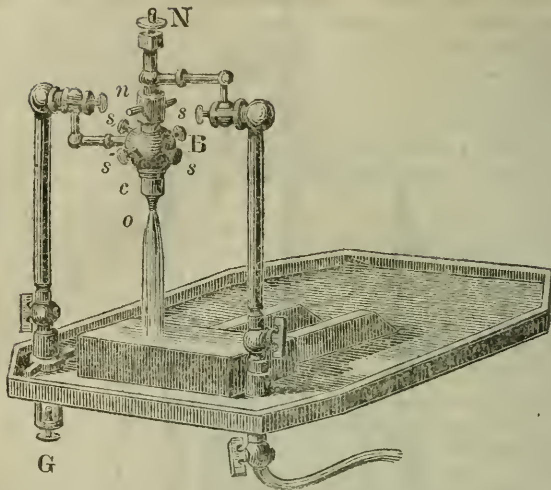
This reservoir is attached to the compound blowpipe, in order to furnish hydrogen; and may, of course, be used in all experiments, requiring a copious supply of that gas. When this is to be applied to the hydro-oxygen, or compound blowpipe, (figured and described in the next article) the knob at the end of the pipe, which has an orifice on one side, is placed under the gallows, (G) and fastened air tight to the pipe of that instrument, by the pressure of the screw of the gallows.



Engraving and description of a Compound Blowpipe used in the laboratory of the University of Pennsylvania, by its inventor, R. Hare, M. D.

The following figure represents a compound blowpipe, which I contrived and executed myself, about eleven years ago; but, fearing it might be deemed unnecessarily complex, I have never published any account of it. Experience has shown, that the complication of its structure, does not render it more difficult to use, than the simplest instruments intended for the same purpose; while its parts are peculiarly susceptible of advantageous adjustment.

B is a brass ball, terminating in a male screw above, and in a female screw below. The ball has a vertical perforation, which commences with the lower screw, and terminates with the upper one. Another perforation, at right angles to this, causes a communication with the tube, which enters the ball at right angles. A similar, but smaller brass ball, may be observed above, with perforations similar to those in the larger ball, and a tube in like manner entering it la-



terally. This ball terminates in a male screw below, as well as above; and the thread of the lower male screw is curved to the left, while that of the larger ball, which enters the same nut (*n*) is curved as usual to the right: hence the same motion causes the male screws to approach, or recede from, each other, and thus determines the degree of compression given to a cork which is placed between them, in the nut. At the top of the ball, a small screw may be observed, with a milled head. This is connected with a small tube which passes through a cork in the nut, and reaches nearly to the external orifice, from which the flame is represented as proceeding. This tube is for the most part of brass, but at its lower end, terminates in a tube of platina. Into the female screw of the larger ball, a perforated cylinder of brass, (*c*) with a corresponding male screw, is fitted. The perforation in this cylinder, forms a continuation of that in the ball, but narrows below, and ends in a small hollow cylinder of platina, which forms the external orifice of the blowpipe (*o*.)

The screws (s s s s) are to keep, in the axis of the larger ball, the tube which passes through it, from the cavity of the smaller ball. The intermediate nut, by compressing, about the tube, the cork, which surrounds it, prevents any communication between the cavities in the two balls. By the screw (N) in the vertex, the orifice of the central tube may be adjusted to a proper distance from the external orifice.—Three different cylinders, and as many central tubes, with platina orifices of different calibres, were provided, so that the flame might be varied in size, agreeably to the object in view.

I have always deemed it best, to transmit the oxygen gas through the tube in the axis; since two volumes of the hydrogen, being required for one volume of oxygen, the larger tube ought to be used for

the former: and the jet of hydrogen is placed between a jet of oxygen, within it, and the atmospheric air without.

Under the table, is a gallows, (G) with a screw for attaching a pipe, leading from a self-regulating reservoir of hydrogen.

Society for the Promotion of Internal Improvement, &c.

REPORT ON ROMAN CEMENT.

Letter of J. I. Hawkins, Esq. to Mr. Strickland, ccompanying a report upon the manufacture of Roman Cement, &c.

London, Oct. 31*st*, 1825.

Dear Sir,—I regret exceedingly, that circumstances against which I could not provide, have put it out of my power to make the inquiries on the subject of iron, which I contemplated, and which are necessary to the completion of my intended report upon the process of making iron and steel.

I have not yet been able, and I do not now see a very near prospect of being able, without injury to Messrs. Perkins & Co. to shift from myself the care of their concerns, and, therefore, cannot promise the Report in any given time, but it is my intention to complete it as soon as practicable, and forward it to you in Philadelphia; taking the chance of its containing so much information, not anticipated through other channels, as may entitle it to the favourable attention of the Society for which you act.

I have the pleasure, however, of herewith furnishing you with some samples of the stone, from which the Roman Cement is made, together with a description of the same, and of the mode of preparing the cement; which samples and description, I beg you to present to the Pennsylvania Society for the promotion of the Internal Improvement of the Commonwealth, as a small token of my cordial feeling for the interests of that state, in which I formerly spent several happy years, and within, or in sight of which, on the banks of the Delaware, I fully expect, and intend, to terminate my ramblings, in little more than six months from the present time.

I hope this packet may reach you in time for your embarkation, but if it should not, I shall request Messrs. Curwen & Hagarty, to forward it by the first opportunity.

I have sent small specimens, for the sake of making a small packet for you; but I have endeavoured to select such as will fully show the character of the stone.

Yours, &c.

JOHN J. HAWKINS.

W. Strickland, Esq.

To the Pennsylvania Society for the Promotion of the Internal Improvement of the Commonwealth.

Gentlemen—From many years residence within the state of Pennsylvania, I feel strongly attached to the interests of the Common-

wealth, and am desirous of contributing any information toward its improvement, which more than twenty years of association with the principal engineers of Great Britain, and an extensive practice as an engineer in this country, have enabled me to acquire.

I therefore gladly accede to the request of Mr. Strickland, made me when he was lately in London, that I would furnish you with some specimens of the Roman Cement stone, together with my views, as to the situations, and circumstances, under which that most valuable production should be sought for.

I make this communication with the more confidence, that success will crown the pursuit, since I am informed that the stone has been found in the state of New York, in consequence of some specimens and advice, which I gave seven or eight years ago, to Mr. Canvass White, of Whitesboro', in that state, and that the cement made from that stone, was used in executing the locks of the New York canal. Nor do I forget, that in making an effort to promote the improvement of Pennsylvania, I am also aiming at the benefit of New Jersey, of which state I have been near thirty years a citizen; for I am well assured that the improvement of both states will go hand in hand.

The stone of which the Roman Cement is made, is mentioned by Robert Jameson, in his System of Mineralogy, second edition, Edinburgh, 1816, vol. 2, page 195, as a variety of "compact, indurated marl," which he describes as a "ferruginous marl, in which the mass contains a considerable intermixture of oxide of iron. It occurs in spheroidal concretions, called *Septaria*, or *Ludi Helmontii*, that vary from a few inches, to a foot and a half, in diameter. When broken in a longitudinal direction, we observe the interior of the mass intersected by a number of fissures, by which it is divided into more or less regular prisms, of from three to six, or more, sides; the fissures being sometimes empty, but oftener filled up with another substance, which is generally calcareous-spar."

The same stone is described in William Phillips's Elementary Introduction to Mineralogy, third edition, London, 823, page 157, as "a variety of the Argillo-Ferruginous-Limestone," called "The Septaria (Ludus Helmontii) occurring in regular layers in the London clay."

In John Mawe's descriptive Catalogue of Minerals, fifth edition, London, 1825, page 29, the stone is classed as a variety of "clay-iron stone, containing veins of calcareous-spar, (septaria.")

In Andrew Ure's Dictionary of Chemistry, second edition, London, 1823, under the article "Cement," are given, three analyses of "Parker's Patent Cement," by Sir Humphrey Davy, by Loftus, and by Mulgrave, the average of which gives the constituent parts to be, in the nearest round numbers—

Of Silex, - - - - - - - -	23
Alumnina - - - - - - -	7
Oxide of iron, and Manganese,	12
Carbonate of Lime, - - -	55
Loss by heat, - - - - -	3
	100

The specification of the patent granted to James Parker, for the Cement, dated June 28th, 1796, is published in the Repertory of Arts, second series, vol. 18, No. 118, for May, 1811, page 330.

The stones described in the specification, are called "Nodules of Clay," and the invention is stated to consist in reducing to powder, certain stones, or argillaceous productions, called nodules of clay, and using that powder with water, so as to form a mortar or cement stronger and harder than any mortar or cement now prepared by artificial means. I do not know of any precise general term for these nodules of clay, but I mean by them certain stones of clay, or concretions of clay, containing veins of calcareous matter, having frequently, but not always, water in the centre; the cavity of which is covered with small crystals of the above calcareous matter, and the nodules agreeing very nearly in colour with the bed of clay in, or near which they are found. These nodules, on being burnt with a heat stronger than that used for burning lime, generally assume a brown appearance, and are a little softened; and when so burnt and softened, become warm, but do not slake, by having water thrown upon them, and on being reduced to powder after burning, and being mixed with water, just sufficient to make into a paste, become indurated in water, in the space of an hour, or thereabouts."

"The manner in which I prepare and compose this cement is as follows; viz. The stones of clay, or nodules of clay, are first broken into small fragments; then burnt in a kiln or furnace, as lime is commonly burnt, with a heat nearly sufficient to vitrify them; then reduced to a powder, by any mechanical or other operation, and the powder so obtained is the basis of the cement."

"To compose the cement in the best and most advantageous manner, I take two measures of water and five measures of the powder thus described; then I add the powder to the water, or the water to the powder, taking care to stir and beat them during the whole time of intermixture. The cement is then made, and will set, or become indurated in ten or twenty minutes after the operation has ceased, either in, or out of water."

To the information contained in the above extracts, I would add, from my own success in searching for the stone, and experience in using large quantities of the Roman cement, made from the stone found and manufactured in various and distant parts of this kingdom, the following important points.

1. That the stone is found scattered through a stratum of clay, sometimes in digging of wells or pits, but more abundantly, and with little labour, on the shores of the sea, or of rivers that wash the strata of clay.

2. That the stones which are found in wells, or other situations not wetted with salt water, make the cement of a paler colour, than those found on the shores of the sea, or of salt rivers.

3. That the stones found on the sea and salt river shores, make a cement, which on account of the salt, is apt to be disfigured, by the salt oozing out in patches from walls stuccoed with it, but that the salt does not hinder the hardness and durability of the cement.

4. That the stones found in different places, require a different de-

gree of heat, to make the cement of the best quality; but the proper degree will easily be ascertained, by a few comparative trials on the stone itself, when found.

5. That after the stone is burnt, it is easily broken into small fragments by means of stampers, and then reduced to flour by the ordinary mill-stones.

6. That no wet, nor even damp, must be suffered to come in contact with the cement after it is burnt, until the moment of using it, nor must it be much exposed to the air.

7. That the cement may be advantageously used with one half of its bulk of clean sharp sand, and that the sand ought to be well mixed in with the cement immediately before wetting it for use, and not earlier, lest the damp of the sand should destroy the setting powers of the cement.

8. No greater quantity of the cement must be wetted at one time, than can be used in a few minutes, and it must not be disturbed after it begins to set.

9. The test of the goodness of the cement, is, the setting as hard as stone, in from ten to twenty minutes, after being mixed with water enough to constitute a stiff mortar.

10. The cement made from some stones, will admit of being mixed thin enough to run into a mould, in the manner of plaster of Paris; but that made from other stones, will never harden if so much wetted.

11. The cement hardens quicker in damp than in dry situations.

12. The cement will adhere but very slightly to a coat of itself, previously laid on, and therefore it ought always to be laid on for stuccoing, from three quarters to one inch thick, in one coat, leaving an abrupt edge, against which the next mixing must abut.

13. The cement adheres very firmly to bricks, and to some stones, but the bricks must be wetted before being used, or they will absorb so much water from the cement as to prevent its setting.

Accompanying this paper, I send you eight small specimens of the stone, in order that the eye of those who may be induced to institute the search, may become acquainted with the appearance of the substance sought. One of the specimens, from its paleness and softness, appears to have been in a state of growth, when taken from its bed, and seems to warrant the supposition, that the stone is constantly forming in the beds of clay.

I have heard that a substitute for the above described stone, has been found in some other very poor iron-stones, but I have never seen any of the cements said to be made from them, nor have I heard any good account of such cements.

In the hope that the stone may speedily be discovered, and conduce to the promotion of the objects of your excellent institution,

I remain, Gentlemen,

Your warmly attached fellow citizen,

JOHN ISAAC HAWKINS.

London, *Oct.* 31*st*, 1825.

Note.—The specimens referred to in the foregoing report, are left with the publisher, (Mr. Dobson,) who will exhibit them to any gentleman who wishes to examine them.

Observations on the production of Sugar, as an appendage to common farming.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir—You, in common with every man of observation, must have noticed the great alterations which, within a short period of time, have taken place in the circumstances and habits of society. Many articles, which, a few years since, were considered as luxuries, have now taken their station among the necessaries of life. If these are to be enjoyed, we must pursue the course which is necessary to their attainment. Labour, is the only means which nature has given to man for the procurement of either necessaries, comforts, or luxuries; and by her laws, this labour is productive, in proportion to the skill by which it is directed. The fabrics, worn by our sires, might still have answered the purposes of their descendants; but the improvements of Arkwright, Watt, and others, have so far facilitated the production of cloth, that what fifty years ago, would have been considered as articles of luxury in dress, are now in common use, and viewed as absolutely necessary. This change in the habits of society, is quite as remarkable in our food, as it is in our dress, our furniture, and other modes of living.

I wish at present, to call your attention, to the extraordinary increase of the consumption of sugar, which, in many instances, now forms a part of breakfast, dinner, and supper, even in the families of the poor. It is no uncommon thing with labouring people, to have tea with their dinners; and they argue that, as a beverage, it is preferable to beer or spirits, and equally cheap. To discuss the merits of this question, is not the object which I have in view, as any thing that either you, or I, could say, would have but little influence upon the habits of society; now-a-days, a pauper in the alms-house, gets tea once or twice a day: this, a century ago, was a luxury, which had to be secured to great ladies, by a clause in their marriage contract.

The revolution, is still going forward, which has brought people to live in better, and cleaner houses; and in its progress, it will undoubtedly cause some things heretofore considered as necessary, to be entirely relinquished, or very sparingly used; because they will be found to be incompatible, with the style, and quality, of other things about us. Of this class, we may instance tobacco, as its use in chewing, smoking, and snuffing, do not suit the cleanly habits, and the good furniture, which refinement is introducing into modern use. Elegant carpets, well-papered rooms, &c. are every day lessening the consumption of tobacco. The honours so well earned by *Arkwright*, by *Watt*, by *Fulton*, and by *Whitney*, will be equally due to that benefactor of the human race, who shall introduce into our style of living, something that will be a remedy for the consumption of alcohol. Perhaps increasing the quantity, and lessening the price of sugar, may, in some degree, aid in the discomfiture of the wretched habit, and obviate the evils consequent on the practice of drinking intoxicating liquors. Should we succeed in discovering some vegetable easily cultivated, and yielding a considerable portion of sugar, it may be the means of compensating the tobacco-planter, for the loss of his

customers. Those engaged in this branch of tillage, should begin to look around them, for some other employment, for their labourers and their lands; the current is now setting against the use of tobacco, and when once it is considered as disreputable to employ it, were it to be given away, more of it would be wasted, but not more used than now is, excepting among those who are poor, dirty, and ill lodged, like the peasantry of Ireland and Germany.

It is a general, but probably an incorrect opinion, that the sugar-cane, *saccharum officinarum*, and a tropical climate, are our sole dependance, for an abundant supply of sugar. It is true, that sunshine and heat, are essential to the production of vegetable oils, salts, resins, &c. but is equally true, that all these are produced throughout the whole temperate zone; and would it not be arrogant to say, that every discovery and improvement of which agriculture is susceptible, has been already made? Agriculture, like all other *arts*, when united to the *sciences*, will give results of which we, at present, cannot form any conjecture; and, I am convinced that the time will come, when sugar will be obtained from plants not at present cultivated for that purpose, and capable of being raised throughout an extent of country, not now supposed possible.

These observations were suggested by the following circumstance: late last fall, there had been some sharp frosty nights, succeeded by hot sunshiny days; on one of these, I noticed a vast number of flies, of various kinds, swarming about some bundles of broom-corn, *holcus sorghum*, that had been recently cut down; it was evident that they were allured by something in which they were much interested. I at first imagined that the heat and shelter, afforded by the stalks, had brought them together; but upon examination, no remarkable degree of warmth was perceptible; heat and shelter therefore could not be their object; food next occurred as the subject of their attention, and upon carefully examining the stems, I found that on twisting them hard, a table-spoonful of remarkably sweet juice, could be pressed from a single joint, near the bottom of the plant; this solved the inquiry respecting the object of the flies, and perhaps may lead to results of greater importance.

Cuttings from two or three of the lower joints were saved, for the purpose of having them completely pressed; but this, on account of their ripe state, their hard cane-like fibres, and my want of proper means, was found to be a difficult task. This delayed, for a few days, the completion of the experiment, and during this period, it was found, that the juice in the plant, had undergone the acetous, and putrefactive fermentations, which prevented the ascertaining the quantity, and quality, of the sugar, by evaporation, and crystallization as had been determined.

Considering that sugar is an article in increasing demand, that the daily improvements making in the old branches of agriculture, are reducing the profits of the farmer to a minimum, and that sugar, in smaller or larger quantities, is found in many vegetables; would it not be wise in our agriculturalists, throughout the Union, to make experiments upon the cultivation of sugar. The quantity contained in

broom-corn, convinces me that this plant is of sufficient consequence to command their attention, and to procure for it a general and careful trial. The thing is deserving of experiment, to the north as well as to the south. The plant grows in every state in the Union. It is probable that the advantage will be with those who have most heat and sunshine, provided the people are equally industrious, and have this industry under the guidance of equal skill and intelligence; for, in all comparisons of this kind, these must be taken into the calculation, as in many instances, they have power, to more than compensate, for some deficiency in natural advantages.

The improvement, and increase of all useful productions, are objects of national importance; and, perhaps, the editors of newspapers may think these hints worth disseminating. In this case, I hope that they will also aid in making your useful repository more generally known, by giving credit to the Franklin Journal of Philadelphia.

Yours, &c. SACCHARUM.

The foregoing remarks are from the pen of a gentleman, whose "eyes are in his head;" who is a careful observer of the works of nature, with a view to the application of her productions, to purposes of practical utility. In addition to the above, he has urged the propriety, of calling the attention of the agriculturist, to that important product, vegetable oil; the ground-nut, the seeds of white poppy, of sun-flower, of cotton, and many other plants, claim the attention, and promise to reward the labour of the husbandman. It is in the power of the editors of newspapers, to do much good, upon such subjects; particularly at a time when most of the productions of the soil, yield but little profit, and the farmer is, therefore, ready to listen to suggestions, which, in more prosperous times, would remain unheeded.—EDITOR.

Professor Renwick's Review of "An account of experiments to determine the figure of the Earth, by means of a pendulum, vibrating seconds in different latitudes, and on various other subjects of philosophical inquiry. By CAPTAIN EDWARD SABINE, F. R. S. &c."

(Continued from page 172.)

The method employed by the French philosophers, in operations of the same nature, at several points of the arc of the meridian, passing through France, and subsequently by Biot at Unst and Leith, is entirely different; and is the invention of Borda. He suspended, in front of an astronomical clock, a sphere of platinum, by means of a slender iron wire, whose length was about four times that of the clock pendulum; the wire was made of iron, in consequence of the great tenacity of that metal, which would permit it to be drawn of great fineness, without rendering the wire liable to break, by the weight of the ball: the coincidences of this wire, with a cross or mark upon the lens of the clock pendulum, were observed by means of a small telescope placed in front. After the pendulum was brought to rest, its extreme length from the point of suspension, to the lower surface of the sphe-

rical body, was measured, while it remained suspended; the distance between the centres of oscillation and suspension, or the effective length, was found by calculation, founded on well known formulæ, on the supposition that the wire was devoid of weight; and a correction finally applied for the weight of the wire. In this method, each observation is entirely independent of any other, and rests upon its own merits; whilst in the method, employed by Captains Kater and Sabine, in which the *relation* only is determined, which the length of the seconds' pendulum, at the station to which the pendulum of comparison is carried, bears to the length at the station of the fundamental experiment. The correctness of the *absolute* length at those stations will depend upon the accuracy of the original determination. But this need not be a disadvantage, even in determining the *absolute* length at the several stations, because the fundamental experiment may be frequently repeated, until perfect accuracy may be considered as attained; and certainly is none, in the application of the results to the deduction of the figure of the earth: because in such case it is the *relation* only, and not the absolute length, which is the object of *precise* inquiry.

The method of Borda, has recently been altered by Biot, who uses a pendulum of less length; the apparatus may thus be more securely and conveniently carried from place to place, enclosed in a glass case. In spite of this improvement, the method of Kater is well entitled to the preference; the first experiment requires no greater care or precautions, and will occupy less time than every separate determination by the method of Borda, and in every subsequent trial, the British method is very much more speedy, is capable of more accurate and comparable results, and is less dependent either upon external circumstances, or upon the skill of the observer.

Besides the method which we have described, our author made use of two others, as checks upon his experiments; the first was that of an invariable pendulum attached to a clock; the second, arose from the variations in the rate of the astronomical clock in different latitudes: we refer to them only as having fully confirmed the results of his other experiments, for their principle is too well understood to need any illustration.

Captain Sabine, after having recounted his several observations of coincidences of the pendulums; of the rate of the clock with the invariable pendulums; of transits and altitudes of the sun and stars, for the rate of the astronomical clock and chronometers; of meridian altitudes of the heavenly bodies for the latitudes of the places of observation,—all with a fulness of detail, which will enable those who may desire to do so, to trace every step of the process from the original observations to the ultimate conclusions;—proceeds to combine his determinations, for the purpose of calculating the compression of the earth. The mode he employs, using the thirteen stations visited in his voyages, is that given by La Place, in the third book of the *Méchanique Céleste*, founded upon the principle of the least squares.

This calculation gives the fraction $\frac{1}{288.5}$ for the compression: a very remarkable result, in consequence of its being the same that expresses

the ratio of the centrifugal, to the gravitating force. Not content with his own measures, he has next combined them with those of Kater, at the stations of the British, and of Biot, Arago, &c. at those of the French survey; and in every combination he is led to the same result. With such a confirmation, we are warranted in saying, that we conceive this value for the compression of the terrestrial spheroid, is more entitled to confidence, than any other that has yet been given; and when we consider its remarkable agreement with the ratio of the central forces, we cannot help believing that there may be some connexion between the external figure of the earth, and its internal constitution, that still remains to be investigated, and which we consider highly deserving the attention of the few mathematicians in the world, who are competent to the investigation.

This determination of an ellipticity of $\frac{1}{2.885}$, differs much from any other, whether derived from former experiments with the pendulum, from the measure of contiguous, or of distant arcs of the meridian.

It is, however, entitled to the highest confidence, inasmuch, as it is the first that has been drawn from observations of the pendulum, unconnected with any other operation. It is very remarkable, that, whilst the pendulum has a right to be considered as a mode of determining the relation between the polar and equatorial axis, perhaps, more certain than any other, it has never, before the present day, formed the principal object of observation; but has always been confided to the same persons, who were employed either in performing geodetic operations, or in calculating their results. We would not charge these distinguished philosophers with unfairness; they are far above any such suspicion; but would merely remark the singular coincidence that has from time to time been found, between the deductions obtained by means of the pendulum, and by the actual measure of arcs, when used to confirm each other. The French commission, who reported the *Systême Métrique*, inferred an ellipticity of $\frac{1}{336}$ by comparing the degrees measured in France with that measured in Peru; and this oblateness is employed by them as the foundation of that system, so beautiful in theory. La Place, who was one of that commission, calculated the compression of the earth, from 15 lengths of the pendulum, measured at different places, and inferred that it was $\frac{1}{338}$. This, if accurate, might have fairly been received as a strong confirmation; but on examination of his calculation, as given in the third book of the *Méchanique Céleste*, an error in taking out a logarithm will be detected; and correcting this mistake, the deduced ellipticity, by his method of calculation, would be increased to $\frac{1}{319}$. Since that period, and when the compression deduced from the measure of more distant arcs, became $\frac{1}{308}$; and that which agrees with the inequalities in the lunar motion, arising from the shape of the earth, is supposed to be about $\frac{1}{306}$; the same illustrious author, by admitting the new observations of Biot, and Arago, infers from the general combination of pendulum experiments, an ellipticity of $\frac{1}{310}$. No better proof can be afforded than this, of the facility with which the few observations that had been made, before the pendulum was taken up by Great Britain, as a distinct and independent method, could be

made to agree with any hypothetical oblateness of the terrestrial spheroid. when examined merely for the purpose of confirming or disproving the calculations, whose data are derived from other sources.

It is now time that the pendulum should assume the rank of an independent measure of the relation between the two diameters of the earth; and the credit is due to Captain Sabine, of having been the first experimental philosopher, who has distinctly asserted its equal claim, as well as proved by his experiments, its right to be so considered. His experiments have, in fact, done more than place it on an equality, as present authority, with the measurement of terrestrial degrees: in his hands, it has become the only method of deducing the figure of the earth, which, as yet, has given a precise and determinate result.

We fully concur in Captain Sabine's opinion, that the satisfactory and conclusive nature of the result, which the pendulum has afforded, when the experiments with it, have thus been duly and sufficiently extended, presents a strong ground of encouragement to attempt an equally conclusive result, by the comparison of terrestrial measurements undertaken on the same decisive scale, of which, his experiments with the pendulum, afford the example. He has suggested a proceeding towards the attainment of such a result, which we cannot do better than lay before our readers, adding our persuasion that it is well entitled to the serious consideration of every man of science, who, either in his public or private capacity, may have it in his power to promote its execution.

"The success which has thus attended the attempt to carry into effect, under the conditions most favourable for the experiment, the method of investigating the figure of the earth by means of the pendulum, and the consistent and precise result, far exceeding previous expectation, which, under such circumstances, it has been found to afford, encourage the belief, that an equally satisfactory conclusion, and one highly interesting in the comparison, might be obtained, by the measurement of terrestrial degrees, performed also under the requisite conditions to give its due efficiency to the method of experiment. Experience has fully shewn, that no result of decisive character is to be expected from the repetition or comparison of measurements in the middle latitudes; and that it is only from operations carried on, in portions of the meridian widely separated from each other, that such an event can be regarded as of probable accomplishment. The project of the original experimenters,—of those eminent men, who nearly a century ago, devised and executed corresponding measurements at the equator and at the arctic circle,—was of far more vigorous conception, than the steps of their successors have ventured to follow, even to the present period; and it is due to their memory to recognise, that the failure on that occasion, was not from insufficient extension of view, or from deficiency in the spirit of enterprise; but from the attempt having been made in the infancy of practical science, when the instruments were inferior, and the modes of their most advantageous employment, less understood, than they have since been rendered.

"The discordancies, which appear in the comparison of the mea-

surements hitherto accomplished, are not so great as those which had resulted from the comparison of pendulum experiments, previously to the present attempt to give the latter method, its full and efficient trial: it has been also seen, that in proportion as the arcs have been enlarged, so as to include the continuous measurement of more extended portions of the meridian, and as the processes of operation have been conducted with improved means, and increased attention to accuracy, the anomalies have progressively diminished; the prospect, therefore, that they may be made wholly to disappear, by combining the interposition of the greatest interval between the measurements that the meridian of a hemisphere will admit, would seem sufficiently probable to justify and induce the undertaking.

"Through the munificent liberality, and splendid patronage of the East India Company, India already presents a determination of the arc contained between the 10th and 20th parallels: and as a consequence of the political changes which have recently taken place in South America, there is reason to hope, that the impediments to a measurement between the equator and the 10th degree, in the quarter of the globe, best suited for the operation, will speedily be removed.

"In regarding the polar extremities of the meridian, the attention is naturally directed in the first instance, to Spitzbergen, as the land of highest convenient access in either hemisphere; its qualification, in that respect, is indeed far beyond comparison with other lands, and is a point of very principal importance; its high latitude and conveniency of access, do not, however, form its only suitability; for, on due consideration, it will be found to possess many very peculiar advantages for the operations of a triangulation.

"The general geological character of Spitzbergen, is a group of islands of primitive rock, the ordinary hills of which, are from 1000 to 2000 feet in height, commanding generally extensive views, and unincumbered with the vegetation which presents so great an obstacle to the connexion of stations in the more genial climates. The access to all parts of the interior is greatly facilitated by the extensive fiords and arms of the sea, by which the land is intersected in so remarkable a manner; these, whether frozen over, as in the early part of the season, or open to navigation, as in the later months, form routes of communication suited to the safe conveyance of instruments either in sledges* or in boats; the fiord, in particular, which separates the western and eastern divisions of Spitzbergen, would be of great avail; it extends in a due north and south direction for above 120 miles, with a breadth varying from ten to thirty miles, and communicates at its northern extremity, by a short passage across the land, with the head

* Sledges with reindeer trained to draft, and the Fins by whom they are managed, may be hired for the season, at Hammerfest, in any number that might be required. Spitzbergen abounds more in the food of the reindeer, and is more plentifully stocked with the animals themselves in their wild state, than any other arctic country which I have visited. The officers of the Griper killed more than fifty deer on the small islands which form the northern part of the harbour of Fairhaven.

of another fiord, proceeding to meet it from the northern shores of the island; and affording similar facilities for carrying on either a triangulation or a direct measurement, on the surface of the ice, at the level of the ocean. It is hardly necessary to add, that the latter operation would be unembarrassed by the inequalities of surface, and uncertain temperature of the apparatus, which occasion so much trouble, and require so much precaution in the usual determination of a base.

"The extent of the arc in the direction of the meridian, between the southern shores of Spitzbergen and the islands on its northern coast, in the eighty-first degree of latitude, is between four and five degrees. At the period of the celebrity of Spitzbergen as a fishing station, in the middle of the seventeenth century, when above 200 vessels, manned by 10 or 12,000 seamen, annually resorted to its vicinity, and frequented its harbours for the purposes of boiling oil, and when the harbours were divided by convention, amongst the vessels, in consequence of their numbers, according to the nation and towns to which they belonged, all parts of the coast were known to, and visited by the hardy and enterprising Dutch and German seamen, by whom the fishery was then principally conducted. The whales have long since deserted the haunts which their kind had enjoyed for ages before in unmolested security, and have sought retreats less accessible to man; the graves, which occupy every level spot around the harbours, contain the only, and, in that climate, the almost imperishable memorials of the once busy scene, which has reverted to its original solitude; even the accidental presence of a whaling ship, in the western harbours, is an event of rare occurrence,* and it is probable that more than half a century has elapsed, since any vessel has passed to the north-eastern shores; it is not surprising, therefore, that the delineation of land, represented in the charts of the period when Spitzbergen was so greatly frequented as existing to the east of the seven Islands, and to extend in a northerly direction far into the eighty-second parallel, should neither have been established nor disproved by modern authorities; those persons who have had opportunities of becoming acquainted, by examination on the spot, with the remarkable correctness of the older charts in general, in the insertion and in the relative position (when not separated by much extent of ocean) of lands then recently discovered, will hesitate too hastily to reject their testimony, until it has been satisfactorily disproved; should land exist as represented in the charts of the period alluded to, even though not visible from Spitzbergen, its triangular connexion might be established on the surface of the ice, and latitudes yet unattained be included in the operations of the survey; nor would it be safe to assign too con-

* During the Griper's stay of three weeks in the neighbourhood of the harbour, of principal resort in earlier times, and in the middle of fishing season, not a single whale fish, or whaling ship was seen. The only vessels which now frequent the shores of Spitzbergen, are Norwegian sloops in quest of Sea Horses, and eider down. Their visits have been hitherto confined to the fiords and the islands on the southern and western coasts; they arrive early in March, and remain as late as November, making occasionally three voyages in a season.

fidently the northern limit of such operations, even in the absence of land, in our present ignorance of the facilities which the ice itself may afford, for their extension towards the pole.

"The measurement of a portion of the meridian, in the higher latitudes, is, however, one of the many experimental inquiries, beyond the reach of individual means to accomplish, for which the advancement of natural knowledge is delayed; if its accomplishment may be hoped for by that nation, which has been most forward in exploring the regions of the north—to whom its climates, and its natural difficulties are familiar—it must still await the existence of a channel in one of the departments of the state, through which the liberal disposition of the British government to forward every undertaking worthy of a great nation, and by which it may occupy an additional page in history, shall be rendered available to other branches of scientific research, than those which are immediately conducive to the interests of navigation."—p. 360—364.

There can be no question that the measurement of an arc of the meridian of Spitzbergen, of sufficient magnitude, to render inconsequential the irregularities in the direction of gravitation at its extremities, (and such would be an arc of 4½ or 5 degrees,) would be one of the most important, as well as one of the most splendid, of those enterprises, for the advancement of general knowledge, which, from time to time, have received the support of enlightened governments, and have commanded the admiration of all civilized nations. To those persons, to whom the climates of the north, and the difficulties presented by its icy seas, and barren shores, are not as familiar as they are to our author, the natural impediments to the accomplishment of such an undertaking, may appear in a more serious light, than they are viewed by him, who has had experience of the means by which they may be surmounted, and has himself proved, that such extreme situations, are not incompatible with the utmost accuracy of experiment. But we do not hesitate to say, that the attempt, even if it should terminate in demonstrating the impracticability of accomplishment,* would do honour to the government, and the country, by which it should be made; and, that there is no country so competent to the undertaking, as Great Britain; nor any time so suitable as the present; when the experience which she has gained in her northern voyages, (which have long since ceased to have any more important practical object in view, than the acquisition of such experience, and the cultivation generally of a spirit of enterprise,) may be most advantageously applied in the attainment of a purpose, of the highest rank in the advancement of science; and in the general interest of which, the nations of every quarter of the globe, and of all succeeding periods, will participate. It is time that Great Bri-

* We are happy to have it in our power to state, that the proposed measurement of an arc at Spitzbergen, was brought under the notice of the President and Council of the Royal Society, previously to the last recess; and that the propriety of recommending to the government an undertaking so important to the advancement of natural knowledge, is now under consideration.—*Editor, Quarterly Journal.*

tain, pre-eminent as she is in commercial enterprise, and in that of maritime and geographical discovery, with wealth at command, and a government well disposed to "forward every undertaking worthy of a great nation, and by which it may occupy an additional page in history," should assert a like pre-eminence, (which she does not, at present, possess,) in enterprises of a higher character, than the mere tracing the direction of a river, or the completion of the outline of distant, and, for any useful purpose, unprofitable shores.

We proceed to notice, and we shall do so as briefly as possible, the bearing of Captain Sabine's experiments upon the application of the pendulum, as a standard of measure, and upon the experiments which are previously considered to have referred the British linear scale, to a definite length in nature. It is in this relation, that we consider his work as entitled to the greatest attention; because the pendulum furnishes, in all probability, the only natural standard of measure, that is invariable, determinate, and easily determinable; and as such, it has become the subject of legislative enactments, having been adopted in an act passed in the session of 1824, and referred to as the means of identifying the authentic, legal scale of Great Britain: there can be no doubt, however, after the perusal of Captain Sabine's remarks, in pages 364 to 372, that the provision made by the act, is inadequate for the purpose; and there cannot be a stronger evidence of the importance of more consideration being devoted to the subject, than that the provision of an act, designed expressly for the most distant posterity, should thus be shown to be incompetent to its purpose, even before the act itself has arrived in operation. The act declares the British imperial yard, to bear a certain proportion to the "pendulum vibrating seconds of mean time in the latitude of London, in a vacuum, at the level of the sea." It necessarily assumes, consequently, 1st, that the length in nature so referred to, is of a uniform magnitude; and 2d, not only that it has been measured, but that all future measurements must conduct to an identical result.

With respect to the first point, the experiments that are contained in the present volume, show, conclusively, that the latitude of the place, and its elevation above the mean level of the sea, are not the only, nor even the chief circumstances, that affect the length of the pendulum; and, consequently, that the measurement, in any one place, even supposing it to be correctly made, and reduced to the level of the sea, by an amount which should not be arbitrarily assumed, does not determine the *pendulum of the latitude*, because the nature, and density of the substances that compose the upper crust of the earth, at the place of observation, have a most important bearing, and which cannot be neglected. The clock, and the experimental pendulum, were found to be liable to variations, of not less than ten seconds per day, in the same latitude; according to the nature of the materials upon which they rested; and, as all the observations were necessarily made upon the land, it is inferred, that an equal variation in an opposite direction, might be considered as likely to occur, if the experiments could be performed at different points, on the surface of the ocean: the whole difference, then, that might arise from the

action of the different substances that are found on the surface of the globe, may, in the same latitude, amount to no less than twenty seconds; and the difference in the length of the pendulum, at stations differing in local circumstances, but still under the same parallel, might be equal to 0.01 of an inch; or nearly one-tenth of the whole difference of the intensities of gravity at the pole, and the equator, or to $\frac{1}{2000}$th part of the absolute attraction of the earth. It would thus appear, that before the mean force of gravity, in any parallel of latitude, can be inferred with certainty, numerous observations, indeed an almost indefinite number, ought to be made, in or near that parallel, to produce, by their combination, a near result.

With respect also to the allowance to be applied to the length of a pendulum, measured at a height above the sea, to reduce it to what it would have been, if measured at the level, it is shown that the correction which has been recently proposed, for the error arising from the *figure* of the surface, by which the regular decrease of gravity, in proportion to the squares of the distances from the centre is affected, may be safely neglected; but that a far greater uncertainty than from external conformation, and for which it would be far more difficult to assign a specific correction, is involved by the variable density of the materials, on which the pendulum is raised above the surface of the sea. From these considerations, Captain Sabine concludes that the pendulum of a particular *latitude*, cannot become a standard of reference, because its length is not practically determinable; that the pendulum of a particular *city*, London for example, (whereby it is implied that a length measured in one part of the city, should be recoverable by a measurement made in some other part of the city,) is open to the same objections, though in a less degree; but that the more simple standard, and which is of determinate, and determinable magnitude, is the pendulum of a particular *spot;* it being understood that all future repetitions, designed to produce identical results, should be made identically at the same place.

We consider, that Captain Sabine has gone far towards proving, that, in this view, the pendulum is applicable to the proposed object; that, with proper precautions, and by adopting the method of experimenting, which he has pointed out, different observers, using different instruments, may arrive, with certainty, at identical conclusions: at least so nearly identical, as not to differ in the fourth place of decimals of a British inch.

But he has also shown, (pages 213 to 233,) that the method which was previously adopted, and employed in the experiments which are considered by the act of parliament to have determined the length of the seconds' pendulum in the latitude of London, does by no means insure identity on repetition within the limits declared in the act; because the method is not independent of individual peculiarity, or of accidental circumstance. The conviction is thus forced upon us, of how essential the experiment itself of repetition, is; and that it is expedient to prove, that a method will produce identical results, in other hands than the original experimenter, before it is officially bequeathed, for such purpose, to posterity.

The selection of a spot, the pendulum of which is to supply an invariable length in perpetuity, and which will require to be referred to, not less by foreign nations of the present day, who may desire to compare their standards with that of Great Britain, than by those of more distant ages, who may seek the recovery of the British measures, is by no means an indifferent consideration. It has happened, accidentally, that the original experiments were made in a private house in London: a circumstance which, in itself, must, sooner or later, have obliged their repetition elsewhere. But, if the length of the pendulum is affected by natural local circumstances, to the amount we have stated, (and we think the fact too clearly made out by Captain Sabine, to be questioned,) may not even artificial changes in the character of the place of experiment, produce a similar result, although in a less degree? Can we be assured that the vibrations of a pendulum, in Mr. Browne's house, in Portland place, are the same now, as when, not more than two centuries ago, its site was nearly a mile without the limits of the city? Nor are either of these times identical with that which would be found, were the future observer compelled to seek for the spot amongst masses of rubbish. Nor is this last view of the subject, however improbable or distant, one that is to be entirely neglected. The language, the arts, and the sciences, which are the boast of Great Britain at the present day, are founded upon a basis more secure than that of empire, and will exercise an intellectual supremacy over future ages, should even the fate that has attended the former "glories of the world," overwhelm, at some remote period, her proud metropolis. It must ever be remembered, that on the transmission of her scale, will depend the value to posterity, of every attainment which she either has made, or may make, in which linear measure is concerned; and that, consequently, her fame and her usefulness, in those distant times, may be materially influenced by the provision which she may now make, for its exact transmission.

For these, and for other reasons, which we have not space to state, we should consider it highly expedient, that, whenever Kater's original experiments shall be repeated, for the final verification of the British scale, the proceedings should take place in a public building, and at such a distance from any probable extension of dense population, as may secure a close resemblance to its present state, for centuries; and that, when the pendulum of that spot shall be considered as fully, and satisfactorily determined, other nations, which may be disposed to adopt a similar proceeding, should be invited to a direct comparison of the standards and measurements of the respective countries; not only for the more perfect assurance of accuracy, but in order that the places may be multiplied, on the globe, at which the British measures may be, hereafter, reproducible.

We perceive that we have already attained our limits, in the examination of the subjects contained in little more than half the work before us: the remainder consists of geographical, hydrographical, and magnetic notices of great interest, particularly the latter. The subjects, however, are distinct, and require, in fact, to be treated of, separately; we shall not, therefore, however worthy they may be of

notice, trespass further on the patience of our readers; but shall conclude with recommending its perusal to all persons who take an interest in such investigations, as one of the ablest works with which we are acquainted.

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. 4.

BY P. A. BROWNE, ESQ.

On Mechanics' Liens.

The next point for consideration, as relates to the subject matter of the contract, is,

3. The contract of exchange of labour or materials.

It sometimes happens that mechanics and material men, instead of contracting, in the usual way, for money, stipulate with each other to exchange labour for labour, or materials for materials, or labour for materials. Whether persons thus situated, have a right to file claims against the buildings, has been made a question. The judges of the district court, M'Kean and Ingersoll, were divided in opinion, and the cause was removed to the supreme court, where it has been determined, that the lien is extended to such contracts. S. C. Dec. 1825. Hinchman *v.* Lybrant.

The time within which the contract is to be executed.

The materials may be furnished, either *before* the commencement of the building, or while it is progressing; but if they are furnished *after* the building is finished, no lien is created.

It is no uncommon thing to collect the materials for a building, and prepare the sashes, doors, &c. before the building is commenced; and when this is done in the regular course of business; there would be no equity in excluding them from a lien; but every man is required, to exercise *common care* and *prudence*, in the management of his concerns; and common care and prudence are wanting, where materials are furnished, *after* a building is finished.

Therefore, in the case of the Olympic Theatre, the court admitted as liens, all materials furnished *before* the building commenced, and *while it was progressing*, but they refused to admit any claims, for materials furnished, *after the building was finished.*

The place over which the contract operates.

The law of 1803 was confined to the city of Philadelphia, the district of Southwark, and the township of the Northern Liberties. The act of 1806 speaks of the city and county of Philadelphia; and by several subsequent acts, the benefit has been extended almost over the state.

The second general question is, "Upon *what* does the lien attach?"

The words of the act are, "all and every dwelling house, or other

building;" which expressions, as we have before seen, includes every edifice whatever.

We shall now proceed to inquire, what things are included under the above expressions.

These are: 1. The *lot*.—2. The *appurtenances*.—3. *Fixtures.*

1st. The *lot*.—Although the act of assembly speaks of the lien as attaching to the building only, yet the lot on which it stands, and as much as is required for its necessary enjoyment, is also affected by the lien, and may be sold with the building. It is evident, that the legislature intended to grant to the lien creditors, the *full* benefit of the building, as a fund to pay their debts, and this would not be done by giving the house, and not the lot.

The first case in which this question was made, was Browne *v.* Smith, 2 Browne's Rep. 229, in note. The case was this: The defendant was seized of a lot in the city of Philadelphia, upon which he erected a building, in doing which he contracted debts to material men. After the commencement of the building, the plaintiff recovered a judgment against him, and issued executions, upon which both house and lot were sold. It was contended on behalf of the judgment creditor, that the lien creditors, were entitled to be paid out of so much of the purchase money, only, as represented the building, leaving the proceeds of the lot, to pay the judgment; but Rush, president, delivered the opinion of the court, that the house and lot were both equally subject to the claims of the lien creditors.

The same point came before the district court, for the city and county of Philadelphia, in the case of the Olympic Theatre, but the court expressed no opinion thereon.

The case of Lyle *v.* Ducomb, 5 Binney's Rep. 585, was a decision, by which the mortgagee of a lot of ground, took not only the ground, but the buildings erected subsequently to the mortgage, in preference to the lien creditors, and that decision was founded, in part, upon the reasoning that supports the case of Browne *v.* Smith; and, so far, corroborates Judge Rush's opinion.

2ndly. The *appurtenances* to the building and lot.—There are many things which are usually used with a house, or other building, and which are so inseparably connected with them, that the enjoyment is not perfect without them, these, in law, are called *appurtenances.* The word is derived from the French word "*appartenir,*" to belong to. As it would be extremely inconvenient, and sometimes impossible, to enumerate these, on all occasions, it is a rule of law, that they pass by the grant of the principal. In like manner, they are bound where the principal is bound.

The case of M'Ilhenny *v.* Pratt, before cited, furnishes a very correct instance of the appurtenances being bound; so much so, that we need seek for no other exemplification. A court was laid open, upon each side of which certain houses were erected: now every one will perceive, that if the court was closed, the tenants would have no means of passing to and from their dwellings, and, consequently, the enjoyment of the buildings would be nearly, if not entirely destroyed. The court, then, was a necessary appendage to the house, it was an

appurtenance, or belonging to it, and, as such, was bound by the lien.

3dly. The *fixtures*.

With respect to what are termed in law, *fixtures*, I would observe, that they are of two kinds; those that are accessary to things of a *personal* nature, as to the carrying on of trade, in which case they are considered as *chattels;* and those that are necessary, as accessaries to the enjoyment of the inheritance, when they are considered as a part thereof. It is the latter class only that are bound by the mechanic's lien. The law on this subject, was reviewed in the case of the Olympic Theatre.

The third general question is, what is the nature of the *preference* given?

This may be divided into the following heads: As regards a *previous mortgage.*—As regards a *subsequent* mortgage.—Where there are *two funds.*—As regards a *previous judgment.*—As regards a *subsequent* judgment.—As regards the lien of a vender of the lot.—As regards a rent charge.

As regards a *previous mortgage.*—The act declares that the building shall be subject to the debts of the mechanics and material men, "before any other lien, which originated subsequent (subsequently) to the *commencement* of the building."

Rule 1. The mortgagee of a lot of ground, upon which a building is *afterwards* erected, is preferred, both as to the lot and the building, before the mechanics and material men, whose debts were created in erecting the building.

In the case of Lyle *v.* Ducomb, 5 Bin. Rep. 585, the plaintiff had a mortgage on a lot of ground, the property of the defendant, on which was a *frame* building. Subsequently to the date, and the recording of the mortgage, the defendant pulled down the frame building, and erected a brick one in its place; and the supreme court were of opinion, that the mortgagee had a lien, not only on the lot, but on the *building erected subsequently to the mortgage*, in preference to the workmen and material men.

Rule 2. And if, instead of the mortgage being given for *a debt actually due*, it be given to indemnify the mortgagee against loss in consequence of his drawing notes in favour of the mortgager, yet the mortgagee has a lien on the lot, and the buildings erected subsequently to the date and recording of the mortgage.

Rule 3. In like manner, if the parties, by indorsement on the mortgage agree, that instead of *drawing* notes for the whole amount, the mortgagee shall *indorse* part, for which the mortgage shall be a security, the mortgagee will have a lien for the indorsements, not only against the mortgager, but also against the mechanics and material men, who subsequently erect a building on the lot.

These positions are all supported by the decision in Lyle *v.* Ducomb, in 5 Bin. Rep. 585.

Rule 4. But if a mortgage is given upon a lot, upon which a building is afterwards erected, at the commencement of which building, the six months, allowed for recording a mortgage, had not expired, and

after the expiration of the six months, but before the filing of the claims of the mechanics and material men, the mortgage is recorded, and the property is sold within two years from the commencement of the building, the lien creditors will be preferred to the mortgage.

The ground of this decision is, that the mortgagee has been guilty of latches, in not recording his mortgage within the period prescribed by law; whereas the lien creditors have complied with the conditions of the act of assembly; and the maxim of law is "*vigilantibus non dormientibus, servit lex.*" The law regards those who *watch*, and not those who *sleep*. It protects those who take due care of their property, and allows the neglectful to suffer from their own want of attention.

The case, in which the point came before the court, was Mitchell *v.* Evans, 2 Browne's Rep. 329.

ENGLISH PATENTS.

Specification of the Patent granted to John Fussell, *Edge-tool-maker, for an improved method of heating woollen cloth, for the purpose of giving it a lustre in dressing.*

To all to whom these presents shall come, &c. *Now know ye*, that in compliance with the said proviso, I, the said John Fussell, do hereby declare that the nature of my said invention of an improved method of heating woollen cloth, for the purpose of giving it a lustre in dressing, and the manner in which the same is to be performed, is fully described and ascertained as follows, that is to say:—My invention consists in an improved method of applying steam to the heating of woollen cloth: (that is to say)—After the cloth is perfectly dressed, either by gig machine, or by hand dressing, I roll it upon a hollow roller or rollers, so contrived as to receive, or enclose the list or forrel, by which process, the stains or wrinkles, which are usually produced by rolling the cloth upon the solid roller or rollers in common use, are avoided. I then place the cloth on end, for the purpose of shifting as much of the water, as is usually shifted previously to racking. In the next place I submit the cloth to the action of steam for about three hours, more or less, according to circumstances, either by suspending it over water, in a common furnace, or by placing it in any apparatus contrived for the purpose, and capable of receiving one or more rolls of cloth at a time, or by any other convenient and suitable means, in which steam is, or may be, raised in the usual ways, or conveyed into it from a detached or separate generator, and applied to the cloth; or, if desirable, the steam may be introduced into the roller or rollers, care being taken to prevent the cloth from being stained, by the condensed steam from the forrel. The proper temperature of the steam to be applied to the cloth, may be stated at considerably below the boiling point; but the exact temperature must be regulated by the

judgment of the operator, according to the lustre required, and in some measure also to the capability of the colour to withstand a high moist temperature. When it is desirable to give to the cloth a very high lustre, it may be obtained by shifting less of the water than is usually shifted, previously to racking, and raising the steam to a greater degree of heat, than required to produce a less degree of lustre. In this case, however, the roller on which the cloth is wound, should be made to revolve slowly, during the process of steaming, by mechanical, or other means.

In witness whereof, &c.

Specification of the Patent granted to MATTHIAS ARCHIBALD ROBINSON, *for improvements in the mode of preparing the vegetable matter, commonly called pearl barley, and grits, or groats, made from the corn of barley, and oats, by which material, when so prepared, a superior mucilaginous beverage, may be produced in a few minutes.*

To all to whom these presents shall come, &c. *Now know ye*, that in compliance with the said proviso, I, the said Matthias Archibald Robinson, do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in the following description thereof: (that is to say)—My invention of certain improvements in the modes of preparing the vegetable matters, commonly called pearl barley, and grits or groats, consists of a peculiar mode of drying, and otherwise treating the grain, by which process, its vegetative properties are destroyed, and a meal is produced, divested of rawness, and free from the impurities of husk or fibre; which meal, when so prepared, is soluble in water, and will make a fine mucilage, in a few minutes. Any quantity of pearl barley, or groats, intended to be operated upon, is taken in the state it is usually sold, and the first process in preparing is to cleanse it, by winnowing, from seeds, husks, dirt, dust, and other impurities. After this the grain is carefully looked over, and any extraneous matters, which have not been separated by the winnowing, are then picked out. In this cleansed state, the grain is put into sieves, and spread over their bottoms in level layers, about three quarters of an inch thick. The sieves are then deposited on ledges, in closets heated by steam-boxes, or steam-passages, the temperature of which should be gradually increased to 160° or 170° of Fahrenheit's thermometer. Under this temperature the grain must be suffered to remain, drying gradually, for about four hours, the aqueous parts evaporated, being drawn off by suitable pipes, leading from the hot closets. By these means, the vegetative properties of the grain will be destroyed, and the raw taste removed, without parching or roasting it. When the grain has been thus sufficiently dried, it is spread out in hoppers, or troughs, to cool, and when that is effected, it is to be passed through funnels, to the hoppers, down to steel mills, (if ground by stone, they are liable to gritty substances;) where it is

ground by steam, or any other efficient power; sliders must be introduced into the funnels, for the purpose of regulating the supply. The meal, falling from the steel mills, is received into boxes or receivers, and is thence removed, for dressing, into bolting machinery of the ordinary construction. The cylinders of the bolting machines should be made of fine wire gauze, from twenty-four, to forty-eight, in the inch, and when the meal has passed through the finest of these, it may be considered to be completely fit for use. A table-spoonful of the prepared barley-meal, may be mixed up in two spoonsful of cold water, and when perfectly smooth, one quart of boiling water is to be poured upon it. This being suffered to boil for ten minutes, will produce the mucilage called barley water, which should be then strained through muslin, if required, flavoured with lemon peel or juice, and sweetened with honey, refined sugar, or sugar candy. An excellent food for infants may be made, by mixing the above proportion with milk and water, instead of water alone. It will also be found to be a very desirable material for thickening broths; it may be mixed and introduced into the broth, half an hour before it is taken off the fire. Puddings, of an excellent quality, may also be made from the prepared barley meal; the powder of the prepared groats is to be mixed in the same way, and a gruel may be produced in ten minutes, of a quality very much superior to any other gruel, made from any preparation of grits or oatmeal, heretofore introduced to the public. I am aware, that several variations may be made in the process above described; but I wish it to be understood that I rest my claim of patent right, in a method or methods of drying the grain under a regular temperature, without roasting or parching it, so as to destroy its vegetative properties, and at the same time retain its nutritive qualities unimpaired, and of clearing it from its fibrous and husky parts, after grinding, leaving only the pure and fine meal; by which preparation, the meal is brought into a condition, that will enable it to keep perfectly good, in any climate.

In witness whereof, &c.

To John Ham, *of West Coke, in the County of Somerset, Vinegar Maker, for his new invented, improved process, for manufacturing Vinegar.*

The object of the patentee, is to expose the liquor of which the vinegar is to be made, as much as possible, to the action of the atmosphere; and, for this purpose, he proposes to employ an apparatus that shall not only constantly keep the liquor in agitation, but shall also run it over extended surfaces, and cause it to be separated into drops, that the air may act upon the liquor in its most divided state, and thereby increase the acidity, and promote its rapid conversion into vinegar.

There are no drawings accompanying the specification; but it is proposed to make an aperture in the lid of the vat or other vessel, containing the liquor previously fermented, and to insert a pump

through this aperture, extending to the bottom of the vat, and rising a little above the lid. This pump may be worked by any suitable mechanical power, and which is not only to produce the alternating strokes of the piston, but also to cause the pump to be turned round horizontally.

The upper part of the vat, containing the liquor, is to be occupied with small twigs or bushes, piled upon bearings, placed across in the middle; and near the top of the pump, immediately under the lid of the vat, two or more spouts are inserted, for the discharge of the liquor raised by the pump; and also in the sides of the vat, near its top, there are to be perforations for admitting the air to the interior.

The apparatus being thus prepared, and the liquor to be operated upon occupying the lower part of the vat, the pump is now put in action, when a quantity of liquor raised at every stroke of the piston, will be thrown over the surfaces of the bushes, and these dripping from twig to twig, will, in that divided state, be submitted to the action of the air within the vat, and as the pump continues to revolve, every stroke will throw the liquor on to a different part, and by that means, keep the liquor constantly flowing over the whole surface of the bushes, and descending, by drops, to the bottom.

In this way, by continually pumping, it is intended that the air shall act upon the liquor, and in the course of about fifteen or twenty days the vinegar will be completely made. The acidification of the liquor may, however, be still further promoted, by causing a rapid circulation of the air within the vat, and this is proposed to be effected by employing a blowing machine to force air through the apertures, near the top of the vat, or by employing an exhausting air pump, which shall draw the air from the vat, when fresh air will force its way into the vat, and thereby produce a constant current.

This process may be carried into effect by apparatus constructed in a great variety of ways; it is not, therefore, the intention of the patentee, to confine himself to any particular forms, or dimensions, as he considers that he is entitled to the exclusive exercise of this principle of operating, in every way that it may be carried into effect.

To Moses Poole, *of the Patent Office, Lincoln's Inn, in the County of Middlesex, Gentleman, in consequence of a Communication made to him by a certain Foreigner, residing abroad, for the Preparation of certain Substances for making Candles, including a Wick peculiarly constructed for that purpose.*

This invention is a mode or modes of extracting from tallow a peculiar substance, resembling spermaceti both in quality and appearance, which is designed for the manufacture of candles. The patentee states the invention to be "a mode or modes of clarifying tallow, or any kind of animal fat; and in order to effect this, it is necessary, first, to convert the component parts of the tallow, or fat, into acids, and afterwards to separate one acid, which is in a liquid state, from the other, which is solid."

It may be here desirable, for the sake of information, to mention (though it is not stated by the patentee) that animal fat is chiefly composed of two substances, chemically denominated *stearine* and *elaine:* these substances, when saponified by the admixture of an alkali, produce—stearine, *margaric acid*—elaine, *oleic acid;* the margaric acid being solid and crystalline, the oleic fluid and oily.

The specification proceeds to state, that the liquid acid is fit for most of the purposes to which oil is usually applied, and the solid acid is the substance intended to be made into candles.

There are several processes by which the two acids may be obtained, one by the saponification of the tallow or fat, and another by its distillation. The saponification may be effected by incorporating soda, potash, lime, or any other of the alkalies with the fat, as is commonly done in making soap, and the soap thus obtained, is to be decomposed by a suitable acid, according to the base of the alkali employed. This decomposition should be made in a large quantity of water, kept well stirred during the operation, and warmed by steam introduced in any convenient way. When the mixture has been allowed to stand, the acid of the tallow, or fat, will rise to the surface, and the water being drawn off, will carry the alkaline or saline matters with it; but if the acids of the tallow should retain any portion of the salts, fresh water may be thrown upon it, and the whole well agitated, until the acids have become perfectly free from the alkaline matters; and when allowed to cool, the acids will be formed into a solid mass. This mass is now to be submitted to considerable pressure, in an apparatus such as is employed in expressing oil from seed, when the liquid acid will run off, in the form of a substance resembling oil, leaving a solid matter, similar in every respect, to spermaceti, which is fit for making candles.

The distilling process is effected by submitting the tallow, or fat, to heat, in any ordinary alembic, or distilling apparatus. To facilitate the evaporation, a small quantity of steam may be introduced, which will be condensed over with the other products, in the worm, or other cold receiver, that may be used. The operation may be prolonged, by keeping up a continual supply of tallow; but in this case, the products distilled over must be watched, as they become coloured by this process, and require to be separated, according to their different qualities.

The substances produced by this distillation are, the two acids above described, which, in order to be purified, are to be washed with warm water, as in the preceding operation. The liquid and the solid acids are then separated by pressure, as before described, and if exposed to the air and sun, or treated with alcohol, as is usually practised in the bleaching of wax, the material will be improved in colour.

The above described operations may be combined, for the purpose of obtaining the acids more pure, and free from saline matters; that is to say, after having obtained them by saponification, they may be distilled, and afterwards separated by pressure, as before said.

The patentee says, he does not claim the distinct processes of sa-

ponification, or distillation, but only when combined with the pressing, for the purpose of separating the liquid from the solid acids, after employing either or both of the processes in question.

The wick to be used in the manufacture of these improved candles, and which forms one of the features of this invention, is to be made of cotton yarn, twisted rather hard, and laid in the same manner as wire is sometimes coiled round the base strings of musical instruments. For this purpose, straight rods or wires are to be procured, of suitable lengths, and diameters, according to the intended size of the candles about to be made, and these wires having been covered with cotton, coiled round them as described, are to be inserted in the candle moulds, as the common wicks are, and when the candle is made, and perfectly hard, the wire is to be withdrawn, leaving a hollow cylindrical aperture, entirely through the middle of the candle.

The subject of this patent is the invention of the celebrated French chemist, M. Gay Lussac, and is taken out in this country by Mr. Poole, merely as an agent. The discovery appears to be the result of profound chemical knowledge, and not the effect of mere accident, which frequently happens; the advantages, however, of the invention, as applied to the making of candles, must depend upon the comparative costs of this new material, and spermaceti, for which it is proposed as a substitute, and to be rendered at a lower price.

[*London Journal.*

PATENT LAWS OF DIFFERENT COUNTRIES.

It is believed that the subject of *Mechanics' Liens*, will be completed, in one more number of the essays on "Mechanical Jurisprudence." Those which will immediately follow, will contain a complete view of the patent laws, of Great Britain, and of the United States; both as regards their enactments and operation. The following information, respecting the patent laws of France, Prussia, Austria, the Netherlands, and Spain, will, undoubtedly, be acceptable to many of our readers.

FRANCE.—*By a Decree of the National Assembly.*

Every discovery, or invention, is the property of the inventor, and is secured to him by the law.

Every addition, which is an improvement to an invention, shall entitle its discoverer, to the same privileges as the original inventor.

Whoever shall first introduce into France, a foreign discovery, shall enjoy all the same advantages as if he had been its author.

Persons applying for patents, must state in writing, whether the object he presents is his invention, his improvement, or an importation. He must deposit, under seal, a full account of the principles, and process of the discovery, with plans, designs, or models, to illustrate it.

Patents are granted for FIVE, TEN, or FIFTEEN YEARS, at the choice of the applicant. For a longer term, a special law must be obtained.

Specifications of patents actually in use, are open to the examination of every citizen, excepting when, for special reasons, the legislative body. has allowed an invention or discovery to be kept secret.

Those who infringe patents, are liable to a suit for damages, and whatever infringes the patent, may be seized. For a first infringement, the penalty cannot exceed 3000 livres; for a second, this sum may be doubled.

A patentee may dispose of his patent, like any other property. At the expiration of the term, the description is to be made public.

A patentee forfeits his rights, if, in his description, he conceals the true process, or any part of it; if he be convicted of making use of secret means, not detailed; or shall use any which he does not afterwards add to his description. Patents are void, if taken out for a discovery which has already been described, in a work printed and published; if not made use of for two years after the date at which it was obtained; if the inventor obtain, afterwards, a patent for the same thing, in any other country: should *another person* obtain such patent, the rights of the inventor are not forfeited.

Persons purchasing the rights of a patentee, enjoy the same rights, and are subjected to the same penalties, as the inventor.

The government charges for a patent, are:

For a term of FIVE years,	- - - - - - - -	300 livres.
TEN,	- - - - - - - - - - -	800
FIFTEEN,	- - - - - - - - -	1500
For improvements, subsequently introduced into an existing patent,	- - - - - - - - - - -	24
For legislative prolongation of the term,	- - -	600
For enrolment of the specification,	- - - -	12

Besides these, there are some other small charges, for fees to officers, &c.

PRUSSIA.—*Enacted November 14th*, 1815.

Every Prussian subject is entitled to a grant of a patent, for an invention, an improvement, or an importation. Accompanying the application, there must be drawings, and a specification, explaining the objects and detail of the invention.

The privileges are granted, from six months, to fifteen years, and may be obtained for one or more provinces, or for the whole kingdom.

The patentee is bound to publish in the local gazette, within six weeks, the grant of the patent; the neglect of which formality, invalidates the privilege.

In order to encourage industry, *no tax, or duty*, is levied on patents, excepting stamps, and enrolling official charges.

Whosoever proves, that he made use of the invention, or manufacture patented, previous to the date of the grant, is entitled to continue his own manufacture.

The infringements of patent rights, are prosecuted before the pro-

vincial courts of justice, wherein the offending party resides; and the appeal may, from thence, be carried before the Minister of Finance and Commerce.

The first infringement is punished with the costs of suit, and the interdiction of manufacturing the patented article. On further infringements, the seizure of the tools, and manufactures, are ordered, and the patentee may sue for damages.

A patent becomes invalidated and void,

1. If the manufacture has previously been described, and published, in print.

2. If the patentee has not executed his privilege within a given time.

3. If the patentee has himself obtained, for the same, a patent abroad.

4. If the patented article, or manufacture, is dangerous to public safety, or contrary to law.

The sums deriving from enrolling charges, &c. are to be employed for the encouragement of industry.

The same act states, that all former laws, or privileges, are from hence revoked.

AUSTRIA.—*Enacted December* 8, 1820.

The application for a patent of invention, improvement, or importation, is to be lodged before the provincial board of Directors of the applicant's residence.

A true and faithful specification, with drawings thereof, is required.

The patent, dates from the day, and the hour, of the deposit of the application.

The provincial Director, has ONLY to verify, if nothing in the manufacture to be patented, be contrary to law, and the public welfare.

Patents are to be granted, on the report of the government's committee of commerce and manufactures, appointed for that purpose.

The patent duty, or taxation, is relative to the duration of the patent claimed, which cannot exceed fifteen years.

5 years' duty is - - - - - - - - 50 C. florins.*

For the 6th year, - - - - - - - - - - - 15

For the 7th is 20, and so on, increasing every year, for fifteen years, by the addition of five florins, to the sum last charged.

One half is to be paid at the deposit of the documents, the remainder by yearly instalments, according to the extent of the patent.

In order to promote the patentee's interest, a prolongation may be obtained, before the expiration of the first patent, if it has been taken for less than fifteen years.

Transfers of a patent right must be legally enrolled, at the office of the committee of commerce and manufactures.

* A Conv. florin is about 45 cents.

Infringements may be prosecuted before the common courts of justice; they pronounce the seizure of the counterfeit manufacture—a fine—and damages.

NETHERLANDS.—*Enacted January the 15th*, 1817.

Patents are granted for five, ten, and fifteen years.

The tax or duty to be paid, is from 150 to 750 florins, according to the duration, and the importance, of the invention, or importation.

A five or ten years' patent may be prolonged to fifteen years, if there be sufficient cause shown of the utility of the invention, &c.; but it can never exceed the fifteen years.

Inventions that have been patented abroad, can only be privileged for the time of the original grant.

The patentee may prosecute counterfeiters before the common courts at law, and obtain the seizure of the manufactured article, or machinery, with costs and damages.

The invalidation of a patent arises,

1. From the manufacture being previously known, described, and published.
2. From the patentee not practising, or manufacturing the same.
3. From the patentee himself having subsequently obtained a patent for the same, abroad.
4. From the patented article being dangerous, and contrary to law.

The sums deriving from patents, are to be employed as recompense, and encouragements, to arts and manufactures, &c.

SPAIN.

A law was enacted by the Cortes, October 2nd, 1820, but this enactment has recently been abolished, by the present king of Spain, and no patent law is now existing there; it is, therefore, unnecessary to publish that which has been repealed.

ON IRON AND STEEL. BY THOS. GILL.—No. 4.

On the use of chilled Cast-Iron, for Punches, and other Tools.

It is well known, that in making holes in red-hot iron articles, such for instance as wheel-tire, horse-shoes, &c. the hardened and tempered steel punches become softened, from the effect of the heat; and, changing their shape, must be repaired from time to time.

Mr. Peter Keir, engineer, of St. Pancras, several years since, having occasion to make many nail-holes, in the wheel-tire of artillery carriages, and horse-shoes; and having experienced the above inconvenience in a very great degree, luckily thought of substituting punches made of chilled cast-iron, for those of steel, and which he found fully

to answer the purpose, as they constantly retained their original hardness, notwithstanding they very frequently became red-hot in using.

As, however, chilled cast-iron is not sufficiently tough to bear bending, without breaking, he found it necessary to strengthen his punches, by surrounding and inclosing their stems in cast-iron holes, made of shapes corresponding with the stems, in properly shaped supports, and having their points only standing out a sufficient length for use.

On forming Cutting Tools of Cast-Steel, as hard and tough as possible.

It is well known that the proper hardening heat for cast-steel, is exceedingly difficult to be attained, and that a very little excess of heat is sufficient to deprive it of its most valuable properties; hence, in order to obtain the edges or points of steel instruments, of the greatest degree of strength for important purposes; such, for instance, as the edges of knives for dividing mathematical instruments,—Mr. Stancliffe, an excellent maker of those instruments, and formerly a workman of the late celebrated Mr. Ramsden's, adopted the following most excellent method:

After shaping the tool, and condensing it by hammering, he carefully heated the point, and quenched it: he then, with the edge of a file, made trial, by filing along from the soft and unhardened part, to that part of it, where it became hard; and formed his cutting part, or edge, by grinding and whetting that part to shape. He was thus assured of the quality of his tool being the best that the steel he employed could possibly produce; nor did it require tempering, as usual.

It is to be hoped, that this valuable process, now for the first time published, will be adopted, wherever tools, possessing all the advantages, in point of hardness and strength, which steel can give them, are required.

On hardening Articles made of Steel-Wire, without bending them.

This valuable process was employed by the late Mr. Rehe, of Shoe-lane, a most ingenious mechanic, in the following manner. The articles having previously been carefully heated to the proper degree, instead of cooling them in water, Mr. Rehe threw them upon the flat surface of a fixed block of cast-iron, and instantly rolled them round, by sliding another flat plate of iron over them; and thus, by this revolving motion, he kept them perfectly straight, in the act of being cooled and hardened, between the metal plate, and the block.

On an improved method of softening or annealing Cast-Steel.

It is very singular, that cast-steel should be *softened* by the very same means which are ordinarily employed to *harden* it; and yet such is the fact.

We have constantly seen, that those parts of the stems of drills, which immediately adjoin to the hardened points, are found to twist much more than any other parts; and also, that those parts of chisels, punches, &c. which are next to their hardened edges or points, are

exceedingly liable to bend, unless they have been made much stronger than would otherwise have been requisite. Yet, notwithstanding that these facts were continually presenting themselves to notice, it does not appear that any use has been made of them, by workmen in general.

Some judicious persons, however, have availed themselves of this singular property, and with great advantage; as by it, they are enabled not only to anneal cast-steel, in much less time than by any other method, but also to free it entirely from those hard spots, usually termed *pins*, which occasion so much trouble to workmen, in filing or turning it.

The process consists *in carefully heating the steel, nearly to the hardening point, and instantly quenching or cooling it in water; and the nearer that heat approaches to the hardening point, the softer the steel will become.*

Cast-steel articles ought always to be thus annealed, previously to planishing them, or condensing them by hammer-hardening; and it is wonderful how much they will stretch under the hammer, after being so treated.

On welding Cast-Steel, and Cast-Iron.

We here furnish our readers with extracts from an article, published by us in the "Annals of Philosophy" in March, 1818; but which, we think, ought also to accompany the other articles "On Iron and Steel," contained in this work.

We first noticed the difficulty of welding the higher converted cast-steel to iron; and stated, that the public were indebted to Sir Thomas Frankland, for the first accurate information on the means of performing it: namely, by heating the iron to a welding heat, and the steel as hot as it would safely bear, when, by dexterous management, the union might be effected, without much injury to the steel.

We then stated our surprise, at the information we had recently obtained, from the late scientific Mr. Samuel Varley, of a smith, in the neighbourhood of Chevening, in Kent, being in the frequent habit of welding pieces of cast-steel together, without injury to them; and in this way *could unite two worn out mill-wright's picks, into a new and serviceable one;* and that in order to prove the value of his process, he, Mr. Varley, had broken a bar of superior cast-steel into two parts, and caused the smith to unite them again; and which was done, without injuring the quality of the steel, in the least degree.

We next added, that having mentioned the latter process to many persons of information,—to most of whom it was a new fact,—we learned from that scientific mechanic, Mr. Charles Sylvester, late of Derby, that he had frequently performed it, *and even with greater ease than he could weld iron, as the welding heat of cast-steel is considerably below that of iron;* and that the chief cause of failure in attempting to do it, was, by persons heating it too much, conceiving that it required to be treated like iron, whereby it had been totally destroyed. That it, however, required a different flux from iron, to prevent its oxidation, to which it is extremely liable; and that the welding

sand used for iron, was totally unfit for this purpose. He preferred *finely-powdered glass of borax*, or the greenish-black glass, of which common bottles are made; which consists of sand and alkali only, having no lead in it, as in flint glass; and he thought, that if it were to be fused, with an additional portion of alkali, it would be still better.

We also found, that Mr. George Scott, another ingenious mechanic, had employed the process for three years past; and a few days since, *had thus united four cylindrical rods of cast-steel, each four feet long, and about half an inch in diameter, after being truly turned in the lathe, into one of sixteen feet long, in order to form a triblet for drawing lead pipes upon.*

But, what was yet more singular, in the course of our inquiry, we were informed by Mr. Jonathan Dickson, engineer, of Holland Street, Blackfriars, that *two bars of cast-iron might thus be united*, their ends being previously enclosed in a wrought-iron tube, and heated to a proper degree; the tube serving as a mould, to prevent the fused cast-iron from falling asunder during the operation.

We then mentioned, that in order to promote the success of welding cast-steel, we would recommend the employment of a charcoal fire; and that the pieces, after being formed of a proper shape for uniting, should have the surfaces intended to be joined, filed bright, be coated with borax, and be bound together firmly by bands, hoops, &c. previously to their being put into the fire: or else, that as soon as they were heated sufficiently, to fuse the glass of borax or bottle-glass, they might be coated therewith on their outsides, either by dipping them into those substances powdered, or by sprinkling them over with them; and that no more heat than was absolutely necessary to effect the union, should be employed, and thus the properties of the steel would be as little injured, as possible, by the process.

We concluded, by adding, that it was no unfrequent practice amongst country smiths, *to unite cast-iron to wrought-iron*, in place of using steel, and particularly for the coulters and shares of ploughs, on account of its cheapness; and that for such coarse purposes, it might answer tolerably well.

OF TANNING, LEATHER-DRESSING, DYING, &c.

(Continued from page 146.)

The dressing and the preparing of the skins of lambs, sheep, goats, and other thin hides, though in many particulars, closely resembling the method used with the thick cow and ox-hides, forms, usually, a totally distinct branch of business; and is one in which a good deal of practical skill, and nicety of manipulation, are required, to succeed perfectly. The processes are very various, according to the article required; and this branch of the manufacture, supplies the immense demand of white and dyed leather for gloves; the (so called) mo-

rocco-leather, of different colours and qualities, for coach-linings, book-binding, pocket-books; and thin leather, for an infinite number of smaller purposes. Of these, the *white leather alone* is not *tanned*, but finished by the process of *tawing;* but the *coloured leather* receives always a *tanning*, (generally by sumach,) independently of the other dying materials. The previous preparation of each, or that in which the skin is thoroughly cleansed, and reduced to the state of simple membrane, in which it is called *pelt*, is especially the same, whether for tawing or dying. *It is thus performed, at the best manufactories, at Bermondsey,* near London, a place long celebrated for all branches of the leather business.

By far the greater number of the skins are imported:—of *lambs*, they are thus prepared: the skins are first soaked for a time in water, to cleanse them from any loose dirt and blood, and put upon the beam commonly used for the purpose, (which is a half-cylinder of wood, covered with strong leather,) and scraped on the flesh side with the semi-circular blunt knife with two handles, used for this operation. They are then hung up, in considerable numbers, in a small close room, heated by flues, where they remain to putrefy for a given time, as is easily perceived by the strong ammoniacal odour which issues from them when the door is opened. During this process, a thick filmy slime works up to the surface of the skin, by which the regularity of the process is judged of, and the wool is loosened, so that it readily comes off with a slight pull. Each skin is then returned to the beam, the wool taken off and preserved, and all the slime worked off with the knife, and the rough edges pared away. The skin is then put into a pit filled with lime-water, and kept there from two to six weeks, more or less, according to the nature of the skin, which has the effect of checking the further putrefaction, and produces a very remarkable hardening, and thickening, of its substance, and probably, also, it detaches a further portion of the slime. The skin is again well worked upon the beam, and much of its substance pared down, and all inequalities smoothed with the knife. Much pains and judgment are required in these operations; on the one hand, not to endanger the substance of the skin by the putrefaction, (which, if carried on too long, would soon reduce it to an incohesive pulp,) and on the other hand, to work out every particle of the slime, the least of which, if retained, will prevent the skin from dressing well in the subsequent processes, and from taking the dye uniformly, and well. The skin is then again softened and freed from the lime, by being thrown into a vat of bran and water, and kept there for some weeks, in a state of gentle fermentation, being occasionally returned to the beam. All the thickening produced by the lime is thus removed, and the skin is now as highly purified as possible, and is a thin extensible white membrane, called in this state a *pelt*, and is now fit for any subsequent operation of tawing, or dying, oil-dressing, or shammoying.

The method of bringing *kid* and *goat skins* to the state of *pelt*, is nearly the same as for *lambs*, except that the liming is used before the hair is taken off, the hair being of no great importance, and sold only to the plasterers; but the lamb's wool, which is more valuable,

would be injured by the lime. Kid's-skins will take a longer time in tanning, than lamb's.

If the pelts are to be *tawed*, they are then put into a solution of alum and salt, in warm water, in the proportion of about three pounds of alum, and four pounds of salt, to every 120 middle-sized skins, and worked therein, till they have absorbed a sufficient quantity. This again gives the skin a remarkable degree of thickness and toughness.

The skins are then taken out, and washed in water, and then again put into a vat of bran and water, and allowed to ferment for a time, till much of the alum and salt is got out, and the unusual thickening produced by them, is for the most part reduced. They are then taken to a lofty room, with a stove in the middle, and stretched on hooks, and kept there till fully dry. The skins are then converted into a tough, flexible, and quite white leather; but to give them a glossy finish, and to take off the harshness of feel still remaining, they are again soaked in water, to extract more of the salt, and put into a large pail, containing the yolks of eggs, beat up with water. Here the skins are trodden for a long time, by which they so completely imbibe the substance of the eggs, that the liquor above them is rendered almost perfectly limpid; after which they are hung up in a loft to dry, and finished by glossing with a warm iron. There are other smaller manipulations, which need not be here mentioned.

The essential difference, therefore, between *tanning* and *tawing*, is, that in the former case, the pelt is combined with tan, and other vegetable matter; and in the latter, with something that it imbibes from the alum and salt, (possibly alumine,) and which, certainly, is never again extracted, by the subsequent washing and branning.

The (so called) *Morocco leather*, prepared from sheep-skins chiefly, and used so largely for coach linings, pocket books, and the best kind of book-bindings, is thus made. The skin, cleansed and worked in the way already described, is taken from the lime-water, and the thickening, thereby occasioned, is brought down, not by bran liquor, as in tawing, but by a bath of dogs' or pigeons' dung, diffused in water, where it remains till sufficiently suppled, and till the lime is quite got out, and it becomes a perfectly white clean pelt. If intended to be dyed red, it is then sewed up very tight, in the form of a sack, with the grain side outwards, (the dye only being required on this side) and is immersed in a cochineal bath, of a warmth just equal to what the hand can support, and is worked about for a sufficient time, till it is uniformly dyed; a process that demands much skill and experience. The sack is then put into a large vat, containing sumach. infused in warm water, and kept for some hours, till it is sufficiently tanned.

The skins intended to be *blacked*, are merely sumached, without any previous dying. After some further preparation, the colour of the fine *red* skins being finished, with a weak bath of saffron, the skins, when dry, are grained and polished in the following way.—They are stretched very tight upon a smooth inclined board, and rubbed over with a little oil, to supple them. Those intended for black

leather, are previously rubbed over with an iron liquor, by means of a stiff brush, which, uniting with the gallic acid of the sumach, instantly strikes a deep and uniform black. They are then rubbed by hand, with a ball of glass, cut into a polygonal surface, with much manual labour, which polishes them, and makes them very firm and compact. Lastly, the *graining*, or ribbed surface, by which this kind of leather is distinguished, is given by rubbing the leather, very strongly, with a ball of box-wood, round the centre of which, a number of small equi-distant parallel grooves are cut in, forming an equal number of narrow ridges, the friction of which gives the leather the desired inequality of surface.

[TO BE CONTINUED.]

On an Improvement in hardening Steel Cutting-Instruments. By Mr. E. RHODES, *Cutler, of Sheffield, England.**

The next head of my subject, is, by far, the most important; though perhaps, the least attended to.—*The hardening and tempering of steel*, is a process extremely simple; it requires more of *care*, than skill; on which account, it is in general, performed by workmen very inadequately rewarded: yet, in the manufacturing of an edged instrument, much depends on the nice management of this very simple operation, which either imparts a value to, or renders nugatory, all the labour that precedes, and all that follows it.

Practically concerned, for upwards of forty years, in the hardening of steel; and having had the process to perform, repeatedly, upon the finest and most delicate cutlery (scissors) ever manufactured; having studied the subject with considerable attention; and having accurately observed and noted the result of facts, as they occurred; the writer presumes he may be permitted to speak, on this part of his subject, with confidence.

It is a generally prevailing opinion, amongst men accustomed to the management of this process, that if steel be overheated previous to immersion, an extra portion of heat is likewise required to reduce it, or what is termed *let it down*, to a proper degree of hardness; and that, without this, a good cutting edge cannot possibly be produced. This, to say the least of it, is a miserable and inefficient attempt to remedy one error, by the introduction of another. That this is an extremely injudicious opinion, and that it operates, perhaps, more than any other cause whatever, to produce a mass of inferior cutlery, must be obvious to every one, who thinks at all upon the subject. It may be laid down *as a position*, which is not in much danger of being controverted, that *the lowest possible heat, at which steel can be worked, and become hard, is indubitably the best*; *and that to impart to it any extra portion, is essentially to injure its most valuable properties.* If *overheated*, the pores of the steel become open and expanded, the firm-

* From his Essay on the Manufacture, Choice, and Management of a Razor.

ness of its texture is destroyed, *and it is rendered incapable of sustaining a cutting edge!* It must not, however, be inferred, from these remarks, that any degree of *temper* whatever, will operate to restore to steel the properties of which it has been deprived, by being *overheated.* Workmen, however, acting under the influence of the preposterous opinion here deprecated, manifest great carelessness in the performance of this very critical operation of hardening; always imagining, that the evil effects of this carelessness may be remedied, by resorting to a practice most evidently erroneous.

The reader is desired to keep in mind *the position* just laid down, that *the lowest possible heat, at which steel can be worked and hardened, is indubitably the best.* To men at all acquainted with the nature of steel, no argument will be necessary to establish this important fact: those who are not, may be referred to the foregoing, and the subsequent observations.

It has often been matter of regret to the writer, that *the phraseology of books and common life,* when applied to subjects intimately connected with a particular manufacture, furnishes no terms by which meaning can be so accurately expressed, as by *the technicals of the workshop:* these are always at hand, and the mind continually recurs to what it dare not use; it finds a task imposed upon it—not unlike that of translating from one language into another, in which the sense suffers by diffusion, and yet cannot possibly be compressed. It is, however, hoped, notwithstanding this difficulty, that the subject, here treated of, may be rendered sufficiently intelligible.

Articles manufactured of steel, for the purposes of cutting, are, almost without an exception, hardened from the anvil; in other words, they are taken from the forger to the hardener, without undergoing any intermediate process: such is the accustomed routine; but the mischief it occasions has either escaped observation, or is disregarded. The act of forging steel produces a strong scale, or coating, which spreads over the whole of the blade, &c.; and, to make the evil still more formidable, this scale, or coating, is unequal in thickness, varying *in proportion to the degree of heat communicated to the steel, in forging it;* it is, partially, nearly impenetrable to the action of water, when immersed in it, for the purpose of hardening. Hence it is, that different degrees of hardness prevail, in most razors manufactured: this is, evidently, a great defect; and so long as it continues to exist, a great difference of temper must exist likewise. Razor-blades not unfrequently exhibit the fact here stated, in a very striking manner: what are termed *clouds,* or parts of an unequal polish, derive their origin, chiefly, from this cause;* and clearly and distinctly, (or, rather, *distinctly,* though not *clearly*) show how far this partial coating has extended, and where the action of the water has been yielded to, and where resisted. It certainly cannot be matter of astonishment, that so few improvements have been made in the hardening of steel, when the evil here complained of so universally prevails, as almost

* These clouds are sometimes produced from the blade being heated too rapidly. Wherever they are observed, the razor is of unequal temper.

to warrant the supposition, that no attempt has ever been made to remove it. The remedy, however, is easy, and simple in the extreme; and so evidently efficient in its application, that it cannot but excite surprise, that, in the present highly improved state of our manufactures, such a communication should be made, as a discovery entirely new!

Instead, therefore, *of the customary mode of hardening the blade from the anvil, let it be passed, immediately, from the hands of the forger, to the grinder: a slight application of the stone, will remove the whole of the scale, or coating; and the razor will then be properly prepared, to undergo the operation of hardening, with advantage.* It will be easily ascertained, that steel, in this state, heats in the fire with greater regularity; and that, when immersed, the obstacles being removed, to the immediate action of the water on the body of the steel, the latter becomes equally hard, from one end to the other. To this may be added, that, *as the lowest possible heat, at which steel can be worked, and become hard, is indubitably the best;* so the mode here recommended, will be found to be the only one, *by which the process of hardening can be effected with a less portion of heat than is, or can be, required in any other way.* It has, likewise, another important advantage: it prevents the edge from being softened, by grinding on the *first*, or, as it is technically termed, the *dry stone;* a practice which generally prevails; and which frequently so injures the temper of the razor, as to render it an extremely unfit instrument for shaving. These observations are decisive; and will, in all probability, *tend to bring into general use a practice, which cannot but be regarded as a very important improvement, in the manufacture of edged steel-instruments.*

On the Choice and Management of a Razor. By the Same.

It is, certainly, of some importance, that what a man is under the necessity of doing *daily* should be done *well*, and *with as little inconvenience as possible.* Shaving with a *bad*, or even an *indifferent razor*, may properly be regarded as *one of the miseries of human life.* It is an operation which men rather submit to than solicit: it is occasionally attended with pain, and as it cannot be avoided, it is, at any rate, desirable to lessen its unpleasantness. Hence every *novelty*, in the form and make of a *razor*, or even of a *strop*, have hitherto been caught at with some degree of avidity; the delusions have had their day, and, in all probability, answered the purposes for which they were created.

A few remarks on the *weight* and *form* of a razor will suffice, its primary excellence consisting in qualities of another description; namely, in its regularity and fitness of *concavity*, its *hardness*, and the *durability* of its *edge.* Weight and form are, notwithstanding, of some importance, and entitled to particular attention. The length of a razor, which generally varies from four to five inches, if manu-

factured on regularly established principles, determines its relative weight. It is essential, that the thickness of the back of the blade, should bear a correspondent proportion to its breadth, which, generally speaking, should be as one to three and a half, though, indeed, this proportion may be permitted to vary a little; it should, however, be understood, that the farther it is departed from, the more unserviceable does the razor become; the reason is obvious: a razor is honed, or whetted, by resting equally upon the back and the edge; if, therefore, this operation be performed upon a narrow blade, with a disproportionately strong back, a short and thick edge is produced, not any way calculated to serve the purposes of shaving, with advantage. If, on the other hand, the blade be broad, and the back light, it is impossible to avoid forming a long and thin edge, which cannot be sustained for a moment, against the opposition of a strong beard. It is, therefore, evident, that justness of proportion, with respect to breadth and thickness, is more to be attended to, than length; this latter, indeed, is so entirely and completely matter of choice, that any observations upon it would be obviously superfluous. The strength or thickness, and of consequence, the weight of what workmen term the *tang*, or the finger-hold of the blade, is, likewise, a circumstance worthy of notice. A requisite proportion should here be preserved, otherwise the utility of the best manufactured razor may be considerably diminished: if thick and heavy, the weight of the cutting part of the blade is so much reduced, that great pressure is required to make it bear upon its work; if thin and light, similar to the razors manufactured in France, it cannot be held firm in the hand; each extreme should therefore be avoided: undue strength or weight in the handle, may, likewise, produce the former of these effects.

A question here naturally arises: how are the defects above alluded to, to be detected, by persons unaccustomed to the manufacturing of razors? If the eye, which almost instantly observes any thing approaching to disproportion in the parts, should in this instance be an insufficient guide, let the *hand* be resorted to; it may here prove a more competent detector. Thus, before a razor is purchased, let it be tried, in the same position in which it is held during the operation of shaving; if *thin* in the tang, it will soon be discovered that it cannot be maintained in a cutting direction, without a much stronger and firmer grasp, than ought to be employed on so delicate an occasion; if *thick* and *heavy*, though it may be held more easily and pleasantly, yet it cannot fail to be observed, that the cutting part of the blade will be so much over-balanced by the weight of the hand-hold, that here again, though from a completely opposite cause, considerable exertion will be necessary to apply the razor, with suitable effect.

Sensible of the advantage of a firm, and at the same time, an easy hold of a razor, some cutlers have recommended, that the sides at least, if not the whole of the tang, should be cut in the manner of a file; this rather detracts from the elegance, and the high finish, of the article, but its utility cannot be doubted.

Form is of equal consequence with weight, and not, by any means,

so dependent upon fancy, as is generally supposed ; one form, at least, has decidedly the advantage of another.

Inequality of breadth, which necessarily includes a proportionate inequality of thickness in the back, is, however, liable to objections, that arise, chiefly, from the additional portion of care required in the course of manufacturing, and more particularly, in the very critical process, of hardening the razor ; for, in communicating a requisite degree of heat to the thicker parts of the blade, the thinner, are frequently so much over-heated, that the whole razor is injured beyond remedy, and its utility effectually destroyed. It must be acknowledged, that the occurrence of this formidable evil may be prevented; but it is only by the exercise of more care and caution than are generally used.

A straight-edged razor is by no means adapted for general use. It is, in fact, fitted only for those, who, convinced that every cutting instrument, from a saw to a razor, is composed of a regular succession of teeth, or points, nearer or farther apart, have learned to distinguish between the operation of cutting, and what may, not inaptly, be denominated *scraping*. The latter is, however, the prevailing mode of shaving; it is the practice, in a greater or lesser degree, of almost every man who shaves himself; and as it is an evil which cannot be entirely removed, it must be partially provided against. How far this is within the power of the razor-maker, will, perhaps, appear from the following remarks. It may here be laid down as a principle, that whatever the form of the back of a razor may be, the edge should always describe a portion of a circle.

It must be tolerably evident to every man who thinks upon the subject, and who has paid attention to the manner in which a razor is commonly used, that the *circularly curved blade*, here recommended, even if applied in the very injudicious mode above alluded to, has decidedly the advantage, whether passed over the face obliquely from the point to the heel, or drawn forwards without the least obliquity of direction, that it must, of necessity, cut, even where a *straight-edged razor* would do nothing, but fret or tear the skin, without removing the beard.

After all, it must be admitted, that the advantage which a full-edged razor, has over a straight one, in point of cutting, arises chiefly from a very defective manner of shaving: so long, however, as this defect exists, so long will the full-edged razor claim a decided superiority. It often happens, that men, groaning under this very useful and necessary operation, attribute their bleeding, writhing, and contortions of face, to the badness of the razor, when the principal fault is in themselves.

Scraping is not precisely the same thing as *cutting;* and if, contrary to all good advice, a man will apply the whole edge of a razor to a part of his face, and draw it in a straight line downwards, as a butcher scrapes the bristles from the back of a hog, instead of giving it, at all times, an oblique and cutting direction, he will often find himself in an unpleasant situation, and all the abuse he can pour upon the instrument in his hand, will not furnish an effectual relief.

Form, *weight*, and *justness of proportion*, united with a proper degree of *hardness*, are certainly constituent parts of a *good razor;* yet its excellence depends likewise on its possessing a *regularity* and *fitness* of *concavity*. It is already almost generally known, that this regularity is produced in the process of grinding, by the use of stones of different diameters, varying from *four*, to *twelve* inches, according to the price of the article required; and it cannot have escaped observation, that this circumstance only, constitutes a very essential difference of edge.

The grinding of razor blades on a *four* inch stone, has recently so much prevailed, that a few remarks on its superior pretensions, may be admitted with propriety. It is easily discernible, that a razor, thus manufactured, must, of necessity, possess great thinness of edge; a circumstance which, independent of any other, renders it unfit for general purposes, even though it may be used in some cases with advantage: a strong wiry beard will put all its boasted excellence to the proof: here it will be found, that a less degree of concavity, and of consequence, a stronger and firmer edge, is indispensably necessary. From the observations here adduced, it appears that the concavity of the blade should, at all times, be regulated by the formidableness, or otherwise, of the object it has to encounter. Razors, however, ground upon stones of about *six* or *seven* inches diameter, may be recommended, as best adapted for general use; they are sufficiently hollowed, or ground out, for any service, however hard, to which they may be applied; and they combine a desirable strength and firmness of edge, with a requisite degree of thinness, provided that the strength of the back, and the breadth of the blade, are duly proportioned.

The *concavity* of a razor should likewise possess great evenness and regularity, otherwise a very unequal edge is produced, a defect which every application of the hone will rather increase than diminish, and which nothing but re-grinding, in a more perfect manner, can possibly remove. There is an appearance produced upon the blade of a new razor, by the use of the hone, which affords a certain criterion, by which this formidable imperfection may always be detected. Two lines are produced, the one upon the edge, and the other upon that part of the back, which rests upon the hone in whetting. On examining a razor, these lines are very apparent, and are easily distinguished by their difference of polish; in some razors they are very unequal, and present several variations in breadth, from heel to point; others possess an even, undeviating regularity; these different appearances should be noted with particular attention, as they afford a certain means, by which the most superficial observer may learn to detect defective workmanship in, *one* of the requisites of a good razor. It can hardly be necessary to add, that where this *evenness of line* exists, a *regularity of concavity* cannot, possibly, be wanting; nor where the contrary is the case, can a good cutting edge be expected.

After all that has been said, it must be admitted, that no infallible criterion can be established, by which all the defects that a razor may have, can, with certainty, be detected. Some, indeed, are exposed to observation; others are hidden, and evade it.

Razors were, in some respects, as well manufactured many years ago, as they are at present: it was, indeed, at one time, a principal object *to make razors for use.* Latterly, *they are made to sell, without any other consideration whatever!* Neither the quality of the material used, nor the excellence of workmanship, appears to be at all studied! A cheap and useless instrument is too frequently foisted upon the public; and the reputation of Sheffield manufactured cutlery, is grossly injured by the practice! Yet, amongst the mass of indifferent cutlery, now made in this ancient mart for hardware, many of its best articles, are of the first quality, and equal, if not superior, to any in the world.

Some new, and important, improvements in steel, have lately been attempted, which, if ultimately successful, will be of considerable advantage to the manufacturers of razors, and of every description of fine cutlery. Messrs. Stodart, F. R. S. and Mr. M. Faraday, chemical assistant in the Royal Institution, have made an interesting communication to the Royal Society of London, in which they detail a series of experiments, undertaken for the purpose of ascertaining how far the best refined steel may be improved, by an alloy of other metals. Some of these experiments appear to have been very successful in their results, and may, probably, at no very distant period, prove of essential service to the town of Sheffield. The application of chemical knowledge, to the improvement of the best refined steel, can hardly fail to be attended with beneficial consequences; this beautiful and highly useful metal, has been refined to a degree of purity and excellence, of which it was, at one time, thought utterly incapable; and let no one suppose, that it has attained the *maximum* of improvement; such a conclusion would be not only extremely unphilosophical, but injurious and absurd. The public are therefore indebted to those men, who, by patient and laborious investigation, discover the hidden properties, detect the chemical affinities of matter, and apply the secrets of nature to the useful purposes of life. Messrs. Stodart and Faraday pursued their inquiries patiently, under a num- of discouraging circumstances, and unsatisfactory results. The combinations they anticipated did not always take place; but they finally ascertained the exact proportions, necessary to produce complete and perfect alloys of steel, with silver, platina, &c. The former of these combinations, they say, produces a metal 'harder than the best cast-steel, or even than the Indian wootz; and the articles made of it, prove to be of a very superior quality.' They add, 'The silver alloy may be advantageously used, for almost every purpose for which good steel is required.'

Anxious to ascertain to what extent steel might be improved by the alloy of silver, as recommended by Messrs. Stodart and Faraday, I have undertaken a similar series of experiments, the results of which have all tended to establish the importance of their researches, and the accuracy of their conclusions. My next object was, to bring this improved steel into use, and establish its superiority, by the excellence of the articles to which it was applied. I have now, for nearly twelve months, used this improved steel in my manufactory, and, hitherto,

the razors into which it has been wrought, have, invariably, proved decidedly superior, for fineness and durability of edge, to any article previously introduced into the cutlery manufacture, in any part of the kingdom.

On the Honing and Stropping of a Razor.

Let the hone be seldom, and but sparingly resorted to; and never, unless by frequent and repeated stropping, the *edge* of the razor is entirely destroyed: use the best pale oil, and be careful to preserve the hone clean, and free from dust. Previously to the operation of shaving, it will be found of service, particularly to those who have a strong beard, and a tender skin, to wash the face well with soap and water; and the more time is spent in lathering, and moistening the beard, the easier will the process of shaving become. Dip the razor in hot water, before applying it to the face; use the blade nearly flat, always taking care to give it a *cutting*, instead of a *scraping*, direction. Strop the razor immediately after using it, for the purpose of effectually removing any moisture that may remain upon the edge; and be careful not to employ a *common strop*, as the composition with which they are covered, is invariably of a very inferior quality, and injurious to a razor. The strop should always be of the best manufacture, and when the composition is worn off, it will be found particularly useful to rub it over, lightly, with a little clean tallow, and then put upon it the top part of the snuff of a candle, which being a fine powder, will admirably supply the place of the best composition ever used for the purpose. Another excellent mode of renovating a razor-strop, is by rubbing it well with pewter, and impregnating the leather with the finest metallic particles.

In closing these observations, I cannot omit to protest against *the elastic cushion strop*, which, from easily yielding to the pressure of the razor, removes the *fine, keen, flat edge*, produced by the hone, and substitutes *an injurious roundness* in its place. A flat strop, not too much burthened with leather, is best adapted to continue the form, which the edge receives in honing; to admit of any other, is to subvert, in practice, the principles on which a good cutting edge is formed.

Influence of the Moon, on Animal and Vegetable Economy. By Mr. N. MILL.

(TO THE EDITORS OF THE ANNALS OF PHILOSOPHY.)

Gentlemen,—The subject of the moon's influence, has engaged but very little of the attention of the philosophical world, and with the exception of the theory of the tides, has been scarcely noticed. Its influence in promoting, and accelerating, animal decomposition, is known only to a certain class of persons, not the most renowned, indeed, for studying the doctrine of cause and effect, or extending

philosophical knowledge, but who, nevertheless, are sufficiently alive to interest; (namely,) persons in the Navy and Company's service. It is a fact well established and authenticated, by numbers of these gentlemen, who have experienced heavy losses thereby, that if an animal fresh killed, be exposed to the full effulgence of the moon, at certain seasons, and in certain places, a very few hours only, will be sufficient to render the animal so exposed, a mass of corruption; whilst another animal, not exposed to such influence, and only a few feet distant, will not be in the slightest manner affected. It would be impossible, in the present imperfect state of our knowledge of this luminary, and its influence, to draw any just conclusions from so few facts, as have been collected upon this subject; but it will be most desirable to accumulate them as much as possible, in order to deduce some accurate reasoning from them; I therefore subjoin some facts, which have come to my knowledge, of the highest practical importance to this maritime nation; and the disclosure of which, I trust, will open a field for investigation, that has, hitherto, been uncultivated, and neglected. The influence of the moon on vegetation, has not altogether been unobserved, because fruit, when exposed to moonshine, has been known to ripen much more readily, than that which has not; and plants shut out from the sun's rays, and from light, and consequently bleached, have been observed to assume their natural appearance, if exposed to the effulgence of the moon. These are also facts fully established, but from which no rational theory has been drawn. A very intelligent gentleman, named Edmonstone, who was for nearly 30 years engaged in cutting timber in Demerara, and who had made a number of observations on trees, during that period, has done me the favour to give me explicit answers to a series of queries, which I presented for his inspection; and which, I doubt not, will be appreciated as they merit. I shall present them in detail, with the answer to each.

Question.—1st. Influence of the moon on vegetation?

Answer.—I have paid but little attention to the moon's influence on any thing exposed to it, but trees; the moon's influence, however, on these, is very great. So observable is this, that if a tree should be cut down at full moon, it would immediately split, as if torn asunder, by the influence of a great external force applied to it. This separation of its parts takes place, I presume, owing to the immense quantity of juice which is contained in the body of the tree. In consequence of this, trees cut at full moon, are of comparatively little use; in a very short time after being cut down, they are attacked by a moth, somewhat similar to what is often found in American flour. Trees cut down at this season, are likewise attacked much earlier by the rot, than if allowed to remain to another period of the moon's age.

Question.—2nd. The nature of the trees?

Answer.—It is impossible to give, in this small space, a statement of the different trees to be met with in the West India Islands, and our Colonies in South America. They are as different as those are which we have in our own country, indeed by far more numerous.

Question.—3d. If evergreens?

Answer.—All the trees in those countries may be stiled evergreens, as there is a constant succession of leaves upon them all.

Question.—4th. Their names?

Answer.—With the scientific names of the various trees to be found in our colonies, in the West Indies and South America, I am unable to supply you. The names given to most of them, are Indian names, applied to them by the natives.

Question.—5th. If usually cut at particular, or in all seasons?

Answer.—The trees intended to be applied to durable purposes, are cut only during the first and last quarters of the moon, for the reasons mentioned in the answer to question 1.

Question.—6th. If the sap rises during the absence of the moon, or during its effulgence?

Answer.—The sap rises to the top of the tree at full moon, and falls in proportion to the moon's decrease.

Question.—7th. Whether common to all trees, or only to certain species?

Answer.—The influence of the moon, over the rising and falling of the juice of trees, is common to all the species of trees with which I am acquainted. I had occasion to observe these effects in the experience of 30 years, amongst the various kinds of wood with which the colonies of South America, abound.

From this statement, it appears obvious, that trees cut at the *full of the moon*, will *split*, as if torn asunder by great external force; that they are more liable to the *attacks of worms;* that they are attacked *much earlier by the rot; and that the sap rises to the top of the tree at full moon, and falls in proportion to the moon's decrease; and this effect is common to all species of trees* with which this gentleman was acquainted.

It will be perceived, that these observations are confined to the continent of South America, and islands adjoining; but if the moon has a correspondent influence in other countries, (which there is no reason to doubt,) and this gentleman's observations be correct, the practical importance of them in felling timber, deserves the utmost thanks, from those persons who are in any way interested in practices of this kind, as well as from society at large.

On changing the Residence of Fishes. By the Same.

(TO THE EDITORS OF THE ANNALS OF PHILOSOPHY.)

Gentlemen,—In reading Dr. Mac Culloch's paper on "Changing the Residence of certain Fishes," in the 34th number of the Quarterly Journal, I was impressed with the importance of the subject, to society; and, I conceive, that any facts which can be collected, in corroboration of his statements, cannot fail to be interesting, and useful. I therefore take the liberty to forward you some facts, which have come under my observation, respecting the habits of the salmon, and the

likelihood of its being domesticated (if I may use the expression) in fresh water lakes and ponds. The salmon has many peculiarities in its history, and mode of living, which are common to most of the finny tribe, that are inhabitants alike of fresh and salt water, and some which others have not. The salmon, during certain months of the year, is an inhabitant of fresh water rivers and lakes that communicate with the sea, and, apparently, for the sole purpose of depositing its ova or spawn. It then again betakes itself to the sea to recruit its strength and vigour, but, unlike other migratory fishes, its retreat cannot be traced; for it is a singular fact, that salmon have never been taken or seen in salt water far from the mouth of some river; and there, only at certain seasons of the year. The herring, the pilchard, the mullet, and the mackerel, may be followed from one sea to another, and from one creek to another; but not so with the salmon, whose *hiding-place* is a mystery, yet to be solved by naturalists. The general opinion, entertained upon this subject, is, that they do not wander far from the shores of the fresh water rivers they frequent, from the well known fact that the *same* salmon will always return to the *same river* to deposit its spawn; and if they do migrate to the northern seas (which some naturalists maintain) where they are found in abundance, but always, it must be remembered, in communication with some fresh water lake or river, it is giving the species credit for greater sagacity than we usually find amongst the animal creation. In ascending fresh water rivers, they surmount the most surprising difficulties; wears or dams of 15 feet in perpendicular height do not present an effectual obstacle to their progress, they are enabled by a spring or leap to pass them with ease. After having deposited their spawn, they become lean and covered with vermin, and fishermen assert, unless then suffered to return to the sea, they die; but this is one of the vulgar notions, which it is my business to controvert. In order to ascertain whether sea water was necessary for the existence and growth of the salmon, I caught some of the fry of this fish, as they were retreating to the sea, with an artificial fly; and preserved them alive, in order to transport them to a fish-pond, the dimension of which was about 30 yards square, with a clay bottom covered with mud; the depth of the water, was from three to four feet, and the pond supplied with a running stream; when first caught, they measured from the tip of the nose, to the tip of the tail, four inches: about twelve months afterwards, the pond was overflowed, when some of the fish, together with some trout, were left dry; they now measured in length eight inches, and assumed the shape, and appearance, of a lean salmon. If, therefore, the young salmon will live for twelve months, in a space of thirty yards square, and three feet deep, and increase in size, the presumption is, that in water where it may range at large, and procure that food and situation which are most congenial to its habits, it would attain its usual size. In propagating this fish in fresh water, the greatest facility presents itself, by transporting its ova or spawn, which is readily discovered in places frequented by salmon, to the places intended for its propagation, choosing, as nearly as possible, the same situation, as that from which it has been removed.

The Chinese, far exceed even the ancient Romans, in the care they bestow upon the propagation of the finny tribe. At certain seasons of the year, they carefully collect all the ova as fast as it is deposited by the fishes, to prevent its being devoured by the other tribes; they then procure some eggs, and, after making a hole in each end, and blowing the inside of it through, the ova is introduced; and the ends being closed, the egg is placed in an oven of a certain temperature, until the young fry nearly make their appearance, when the shell is broken, and the contents put into water warmed by the sun's rays. When the young brood, procured by this means, attain a certain size, a portion of it is applied for the purposes of food for the larger species of fish, and the remainder is destined for the table.

Your obedient servant, N. Mill.

On the Ingots of Copper obtained by solution. By M. Clement.

The beautiful experiments of Sir James Hall, have demonstrated that pulverized carbonate of lime, a substance eminently decomposable by heat, may be fused, under great pressure, without losing its carbonic acid, and afford, when cold, a solid mass similar to marble.

In like manner, as it was heretofore imagined, that that mineral was necessarily formed by deposition, from its aqueous solution, and could, by no means, be a product of heat; so, at present, it is generally believed, that a solid mass of metallic copper, capable of extension, under the hammer, must have undergone igneous fusion, and have acquired its cohesion by cooling. Copper, precipitated from its solution, by whatever agent, is always in the state of a fine loose powder. The following fact, however, will show that an ingot of copper may be formed *viâ humidâ*. I am indebted to M. Mollerat for the observation, which he communicated to me a short time since, on my visiting his fine manufactory for making vinegar from wood, in Burgundy.

In a series of operations for preparing sulphate of copper by calcining copper with sulphur, solutions of the sulphate are obtained, which become turbid by the separation of an insoluble subsulphate. They are placed in a tub, half buried in the ground, in order to become clear. It is against the interior sides of this tub, and always at the junction of two staves, that small buttons (*champignons*) of metallic copper are observed to form, which gradually increase in size, and would, doubtless, ultimately become considerable masses. I have some specimens, which I detached from the tub, with a portion of the wood adhering to them.

On one side we find these bits of copper moulded on the wood of the tub, whose striæ are impressed on their surface; on the other, they have the form of mammellæ with very minute, brilliant, crystalline facets.

One of these specimens weighs more than 75 grammes (nearly $2\frac{1}{2}$ oz. English.)

The chemical action, by which the copper is revived, is easily explained. The protosulphate of copper, which, unquestionably, exists in the solution, in passing to the state of deutosulphate, deposits its base, which gives up its oxygen, and acid, to form the new salt. It is evident that the revival of the copper may be effected, in this manner, without the assistance of any iron, and, in fact, there are no traces of that metal in the interior of the tub. It is not, however, this part of the phenomenon, that appears to me most remarkable, but the cohesion, acquired by the copper, so precipitated, from the midst of a solution; a cohesion, which is so great as to allow the metal to be hammered in the cold, and reduced to thin leaves; and whose specific gravity is equal to that of fused copper, viz. 8.78. I have, moreover, filed a morsel of this copper, and have produced a surface as brilliant, and free from pores, as could have been obtained, by similar means, with an ingot of common copper. [*Annales de Chimie.*

On the Structure of Pearls, and on the Chinese Mode of producing them of a large Size, and regular Form. By John Edward Gray, MGS.

(TO THE EDITORS OF THE ANNALS OF PHILOSOPHY.)

Gentlemen,—Pearls are merely the internal pearly coat of the shell, which has assumed, from some extraneous cause, a spherical form; they are, like the shell, composed of concentric coats, formed of perpendicular fibres; consequently, when broken, they exhibit concentric rings and fibres, radiating from a central nucleus, usually consisting of a grain of sand, or some other body which has irritated the animal. A pearl having been once formed, the animal continues to increase its size, by the addition of fresh coats, perhaps more rapidly deposited on it, than on the rest of the shell, as the prominence remains a source of irritation.

The pearls are usually of the colour of the part of the shell to which they are attached. I have observed them white, rose coloured, purple, and black, and they are said to be sometimes of a green colour; they have also been found of two colours, that is, white, with a dark nucleus; which is occasioned by their being first formed on the dark margin of the shell, before it is covered with the white and pearly coat of the disk, which, when it becomes extended over them and the margin, gives them that appearance.

Pearls vary greatly in their transparency. The pink are the most transparent; and in this particular, they agree with the internal coat of the shell from which they are formed, for these pearls are only formed on the pinnæ, which internally are pink, and semitransparent; and the black and purple specimens are, generally, more or less opaque.

Their lustre, which is derived from the reflection of the light from their peculiar surface, produced by the curious disposition of their fibres, and from their semitransparency and form, greatly depends on

the uniformity of their texture, and the colour of the concentric coats, of which they are formed. That their lustre does depend on their radiating fibres, may be distinctly proved, by the inequality of the lustre of the "Columbian pearls," which are filed out of the thick part, near the hinge of the pearl oyster, *Avicula Margaritifera*, so that they are formed like that shell, of transverse laminæ; and consequently exhibit a plate of lustre on one side, which is usually flat, and are surrounded by brilliant concentric zones, which show the places of the other plates, instead of the even, beautiful, soft lustre of the true pearls.

Some time ago, in examining the shells in the British Museum, I observed a specimen of *Barbala plicata*, with several very fine regular shaped semiorbicular pearls of most beautiful water, and on turning to their superb collection of pearls, I found several fragments of the same shell, with similar pearls; and on the attentive examination of one of them, which was cracked across, I observed it to be formed of a thick coat, consisting of several concentric plates, formed over a piece of mother of pearl, roughly filed into a plano-convex form, like the top of a mother-of-pearl button. On examining the other pearls, they all appeared to be formed on the same plan. In one or two places, where the pearl had been destroyed or cut out, there was left in the inside of the shell, a circular cavity with a flat base, about the depth, or rather less, than the thickness of the coat that covered the pearls, which distinctly proves, that these pieces of mother-of-pearl must have been introduced when the shells were younger and thinner; and the only manner that they could have been placed in this part of the shell, must be by the introduction of them between the leaf of the mantle, and the internal coat of the shell; for they could not have been put in through a hole in the shell, as there was not the slightest appearance of any injury, near the situation of the pearls, on the outer coat.

Since these observations, I have tried the experiment of introducing some similar pieces of mother-of-pearl (which may now be truly so called) into the shell of the *Anodonta Cygneus*, and *Unio Pictorum*, which I have again returned to their natural habitation; and I am in hopes, that some persons, who have more convenience, and are better situated for the purpose, will repeat these experiments, especially with the *Unio Margaritifera*. I found the introduction of the basis of the pearl, attended with very little difficulty, and I should think, very little absolute pain to the animal; for it is only necessary that the valves of the shell should be forced open to a moderate breadth, and so kept for a few seconds, by means of a stop, and that then the basis should be introduced between the mantle and the shell, by slightly turning down the former part, and pushing the pieces to some little distance, by means of a stick, when the stop may be withdrawn, and the animal will push the basis into a convenient place, by means of its foot, and of the 30 or 40 bases which I thus introduced, only one or two were pushed out again, and these I do not think had been introduced sufficiently far. In several which I afterwards destroyed,

I found that the bases were always placed near the posterior slope of the shell, where the pearls are situated in the *Barbala*.

If this plan succeed, of which I have scarcely any doubt, we shall be able to produce any quantity, of as fine pearls, as can be procured from abroad. My reason for believing that this manner of forcing the animals of the freshwater bivalves to produce pearls, is the invention of the Chinese, a nation celebrated for their deceptions and trick, is, that in looking over the collection of shells of Mr. G. Humphreys, I observed that a shell of this species, (the second perfect one that I have seen,) was marked as having come from China.

This plan, at least, is certainly much preferable to the one proposed by Linnæus, and by the above quoted anonymous author, as the pearls are all of a regular form, and that, the one best suited for setting. In cutting these pearls from the shell, it is necessary that the shell should be cut through, so that the mother-of-pearl button may be kept in its place; for if the back were removed, as it would be, were not the shell cut through, the basis would fall out, and then the pearl would be very brittle. The only objection that can be adduced against these pearls, is, that their semiorbicular, and unequally coloured sides, preclude them from being strung, or used any other way than set; but this will always be the case with all artificially produced pearls, as the mantle can only cover one side of them; and the only pearls that well answer the purpose of stringing, are those found imbedded in the cells, in the mantle of the animal.

Note.—Since the above was written, my friend, Mr. Children, has pointed out to me a paragraph, in the Encyclopædia Britannica, vol. vi. p. 477, in which it is stated, "Pearls are also produced by another artificial process. The shell is opened with great care, to avoid injuring the animal, and a small portion of the *external surface of the shell is scraped off.* In its place is inserted a *sphærical* piece of mother-of-pearl, about the size of *a small grain of shot*. This serves as a nucleus, on which is deposited the pearly fluid, and in time forms pearl. Experiments of this kind, have been made in Finland, and have been repeated in other countries."

On the Influence of Solar Light on the Process of Combustion. By THOMAS M'KEEVER, M. D.

There is an opinion prevalent in this, and, I have reason to believe, in other countries, that the sun's rays, or even the ordinary light of day, when admitted freely into an apartment in which a common fire is burning, have the power of dulling it considerably, or should the combustion be going on languidly, of altogether effecting its extinction. Hence, it is a common practice to place screens of different kinds before the fire-place, or to close the shutters of the apartment, in order to prevent, as much as possible, the access of light to the burning materials. I was for a long time impressed with the belief that this was merely a piece of popular prejudice, for which there ex-

isted no rational foundation, whatever, or that, at furthest, the appearances might be owing to the retina having become less sensible to the comparatively feeble rays emitted by a body in a low state of combustion, while already under the influence of a stronger light.* But, as opinions, so generally entertained, usually rest more or less on observation and experience, the best sources of evidence in all such cases, and, as I was unable to procure any information whatever on the subject from the several works on chemistry which I have had an opportunity of consulting, I was induced, during the late summer, when we had such an unusual succession of steady sunshine, to make the following experiments.

Exper. 1.—Two portions of green wax taper, each weighing ten grains, were both ignited at the same moment; one of them I placed in a darkened room, the other I exposed to broad sunshine in the open air: thermometer, in sun, 78° Fahr.; in room 67°; loss as follows:†

In five minutes that placed in sunshine lost . . . . $8\frac{1}{2}$ grs.
darkened room lost . . . . . $9\frac{1}{4}$

Exper. 2.—Two portions of taper, each weighing 23 grains, were placed, under similar circumstances, as in the former experiment.

In seven minutes that placed in sunshine lost . . . . 10 grs.
darkened room lost . . 11

We here see, notwithstanding the higher temperature to which the taper in sunshine was exposed, which must, of course, have favoured the liquefaction of the wax, and, consequently, its ascent in the wick, that, during the short period of seven minutes, there was a difference of loss amounting to not less than one grain.

Exper. 3.—A common mould candle, fourteen inches in length, and three in circumference, was accurately divided into inches, half-inches, and eighths, and exposed, in the first instance, to strong sunshine: thermometer 80° Fahr.; atmosphere, remarkably calm.

To consume one inch, it took	59′	0″
In darkened room (temp. 68° F.)	56	0
In ordinary light of day (temp. 68° F.) . .	57	10

Exper. 4.—A piece of taper, seven inches in length, and six-eighths of an inch in circumference, was carefully divided into inches, and, as in former experiment, submitted to bright sunshine: thermometer 79°.

To consume one inch, it took	5′	0″
Transferred to darkened room (temp. 67°)	$4\frac{1}{2}$	0
In ordinary light of day (temp. 67°)	4	52

* Hence it is that the strongest light appears to produce the deepest shadow. A total eclipse of the sun occasions a more sensible darkness than midnight, being more immediately contrasted with the strong light of noon-day.

† I should mention that in all these experiments the snuff was carefully removed with a sharp scissors, whenever a quarter of an inch of taper was consumed. This was obviously necessary, as the length of the snuff is known materially to influence the rate of combustion.

Exper. 5.—In order to vary the experiment, and to guard, as much as possible against the agitation of the surrounding atmosphere, I procured two lanterns; one of them I coated with black paint; the other I left naked. In these I placed two portions of taper, of precisely equal weights, and exposed them both to a strong glare of sunshine.

In 10 minutes that placed in painted lantern lost . . . . 16½ grs.
that placed in uncoated lantern lost . . . 15*

Exper. 6.—With the view of ascertaining whether similar results were to be obtained by exposure to the light of the moon, I prepared the lanterns as in the last experiment, and took an opportunity, lately, when this luminary shone forth with peculiar splendour, of trying its effects; but, although I employed an exceedingly delicate balance for the purpose, I could detect no difference whatever in the loss sustained by the two portions of taper. [*Annals of Philosophy*.

The remainder of this paper is principally devoted to theoretical considerations, which we have omitted. The truth of the common opinion, respecting the effect of Solar Light upon combustion, appears to be clearly established by the foregoing experiments; a result, it is believed, not anticipated by the Philosopher.

ON GILDING, SILVERING, AND TINNING.

FROM NICHOLSON'S OPERATIVE MECHANIC.

In our second, and third numbers, we have furnished extracts from "The Operative Mechanic," a work of uncommon excellence, recently published in England, by John Nicholson. Messrs. Carey & Lea, of this city, are about to republish it, with considerable additions. The volume consists of about 800 pages, with nearly 100 plates. The American edition will contain 5 or 6 plates of machines, invented in this country, which are not to be found in the original. The mechanic or manufacturer cannot add to his library, a book of greater *practical* utility, than that which is now offered. Particulars may be seen in the prospectus, at the end of this number.

Some of the processes contained in the following extract, will, hereafter, be given more in detail.—Editor.

Gold powder for Gilding.—Gold powder may be prepared in three different ways:—1st, put into an earthen mortar, some gold-leaf, with a little honey, or thick gum-water, and grind the mixture till the gold is reduced to extremely minute particles. When this is done, a little warm water will wash out the honey or gum, leaving the gold behind, in a pulverulent state.

2nd.—Dissolve pure gold (or the leaf,) in nitro-muriatic acid, and

* The diminished rate of consumption in this experiment was, probably, owing to the want of a free current of air through the interior of the lantern.

then precipitate it by a piece of copper, or by a solution of sulphate of iron. The precipitate (if by copper,) must be digested in distilled vinegar, and then washed, (by pouring water over it repeatedly,) and dried. This precipitate will be in the form of a very fine powder: it works better, and is more easily burnished, than gold leaf ground with honey, as above.

And 3d, or the best method of preparing gold powder, is by heating a prepared amalgam of gold, in an open clean crucible, and continuing the strong heat, until the whole of the mercury is evaporated; at the same time constantly stirring the amalgam with a glass rod. When the mercury has completely left the gold, the remaining powder is to be ground in a Wedgewood's mortar, with a little water, and afterwards dried. It is then fit for use.

Although the last mode of operating has been here given, the operator cannot be too much reminded of the danger attending the sublimation of mercury. In the small way here described, it is impossible to operate without danger; it is, therefore, better to prepare it according to the former directions, than to risk the health by the latter.

To cover Bars of Copper, &c. with Gold, so as to be rolled out into Sheets.—This method of *gilding*, was invented by Mr. Turner, of Birmingham. Mr. Turner first prepares ingots or pieces of copper, or brass, in convenient lengths and sizes. He then cleans them from impurity, makes their surfaces level, and prepares plates of pure gold, or gold mixed with a portion of alloy, of the same size as the ingots of metal, and of suitable thickness. Having placed a piece of gold upon an ingot intended to be plated, he hammers and compresses them both together, so that they may have their surfaces as nearly equal to each other as possible; and then binds them together with wire, in order to keep them in the same position during the process required to attach them. Afterwards, he takes silver filings, which he mixes with borax, to assist the fusion of the silver. This mixture he lays upon the edge of the plate of gold, and next to the ingot of metal. Having thus prepared the two bodies, he places them on a fire, in a stove or furnace, where they remain until the silver and borax, placed along the edges of the metals, melt, and until the adhesion of the gold with the metal, is perfect. He then takes the ingot carefully out of the stove. By this process, the ingot is plated with gold, and prepared ready for rolling into sheets.

To Gild in Colours.—The principal colours of gold, for gilding, are red, green, and yellow. These should be kept in different amalgams. The part which is to remain of the first colour, is to be stopped off with a composition of chalk and glue; the variety required, is produced by gilding the unstopped parts with the proper amalgam, according to the usual mode of gilding.

Sometimes the amalgam is applied to the surface to be gilt, without any quicking, by spreading it with aqua-fortis; but this depends on the same principle as a previous quicking.

Grecian Gilding.—Equal parts of sal-ammoniac and corrosive sublimate, are dissolved in spirit of nitre, and a solution of gold made

with this menstruum. The silver is brushed over with it, which is turned black, but, on exposure to a red heat, it assumes the colour of gold.

To dissolve Gold in Aqua-Regia.—Take an aqua-regia, composed of two parts of nitrous acid, and one of marine acid; or of one part of sal-ammoniac, and four parts of aqua-fortis; let the gold be granulated, put into a sufficient quantity of this menstruum, and exposed to a moderate degree of heat. During the solution, an effervescence takes place, and it acquires a beautiful yellow colour, which becomes more and more intense, till it has a golden, or even orange colour. When the menstruum is saturated, it is very clear and transparent.

To gild Iron or Steel with a solution of Gold.—Make a solution of 8 ounces of nitre and common salt, with 5 ounces of crude alum, in a sufficient quantity of water; dissolve half an ounce of gold thinly plated and cut; and afterwards evaporate to dryness. Digest the residuum in rectified spirit of wine, or æther, which will perfectly abstract the gold. The iron is brushed over with this solution, and becomes immediately gilt.

To Gild, by dissolving Gold in Aqua-Regia.—Fine linen rags are soaked in a saturated solution of gold in aqua-regia, gently dried, and afterwards burnt to tinder. The substance to be gilt, must be well polished; a piece of cork is first dipped into a solution of common salt in water, and afterwards into the tinder, which is well rubbed on the surface of the metal to be gilt, and the gold appears in all its metallic lustre.

Amalgam of Gold, in the large way.—A quantity of quicksilver is put into a crucible, or iron ladle, which is lined with clay, and exposed to heat, till it begins to smoke. The gold to be mixed should be previously granulated, and heated red hot, when it should be added to the quicksilver, and stirred about with an iron rod, till it is perfectly dissolved. If there should be any superfluous mercury, it may be separated, by passing it through clean soft leather; and the remaining amalgam will have the consistence of butter, and contain about 3 parts of mercury to 1 of gold.

To Gild by Amalgamation.—The metal to be gilt, is previously well cleaned on its surface, by boiling in a weak pickle, which is a very dilute nitrous acid. A quantity of aqua-fortis is poured into an earthen vessel, and quicksilver put therein; when a sufficient quantity of mercury is dissolved, the articles to be gilt are put into the solution, and stirred about with a brush, till they become white. This is called quicking. But, as during quicking by this mode, a noxious vapour continually arises, which proves very injurious to the health of the workmen, they have adopted another method, by which they, in a great measure, avoid that danger. They now dissolve the quicksilver in a bottle, containing aqua-fortis, and leave it in the open air during the solution, so that the noxious vapour escapes into the air. Then a little of this solution is poured into a basin, and with a brush dipped therein, they stroke over the surface of the metal to be gilt, which immediately becomes quicked. The amalgam is now applied by one of the following methods:—

1st. By proportioning it to the quantity of articles to be gilt, and putting them into a white hat together, working them about with a soft brush, till the amalgam is uniformly spread.

Or, 2ndly. By applying a portion of the amalgam upon one part, and spreading it on the surface, if flat, by working it about with a harder brush.

The work, thus managed, is put into a pan, and exposed to a gentle degree of heat; when it becomes hot, it is frequently put into a hat, and worked about with a painter's large brush, to prevent an irregular dissipation of the mercury, till, at last, the quicksilver is entirely dissipated by a repetition of the heat, and the gold is attached to the surface of the metal. This gilt surface is well cleaned by a wire brush, and then artists heighten the colour of the gold by the application of various compositions; this part of the process is called COLOURING.

To gild Glass and Porcelain. No. 1.—Drinking, and other glasses, are sometimes gilt on their edges. This is done, either by an adhesive varnish, or by heat. The varnish is prepared by dissolving in boiled linseed oil, an equal weight, either of copal, or amber. This is to be diluted by a proper quantity of oil of turpentine, so as to be applied, as thin as possible, to the parts of the glass intended to be gilt. When this is done, which will be in about twenty-four hours, the glass is to be placed in a stove, till it is so warm as almost to burn the fingers when handled. At this temperature, the varnish will become adhesive, and a piece of leaf gold, applied in the usual way, will immediately stick. Sweep off the superfluous portions of the leaf, and when quite cold, it may be burnished, taking care to interpose a piece of very thin paper (India paper) between the gold and the burnisher. If the varnish is very good, this is the best method of gilding glass, as the gold is thus fixed on more evenly, than in any other way.

No. 2.—It often happens, when the varnish is but indifferent, that by repeated washing, the gold wears off; on this account, the practice of burning it in, is sometimes had recourse to.

For this purpose, some gold powder is ground with borax, and in this state applied to the clean surface of the glass, by a camel's hair pencil; when quite dry, the glass is put into a stove, heated to about the temperature of an annealing oven; the gum burns off, and the borax, by vitrifying, cements the gold, with great firmness, to the glass; after which it may be burnished. The gilding upon porcelain is, in like manner, fixed by heat, and the use of borax; and this kind of ware being neither transparent, nor liable to soften, and thus to be injured in its form in a low red heat, is free from the risk and injury, which the finer and more fusible kinds of glass, are apt to sustain from such treatment. Porcelain, and other wares, may be platinised, silvered, tinned, and bronzed, in a similar manner.

To gild Leather.—In order to impress gilt figures, letters, and other marks upon leather, as on the covers of books, edgings for doors, &c. the leather must first be dusted over with very finely pow-

dered yellow resin, or mastich gum. The iron tools or stamps are now arranged on a rack, before a clear fire, so as to be well heated, without becoming red hot. If the tools are *letters*, they have an alphabetical arrangement on the rack. Each letter, or stamp, must be tried as to its heat, by imprinting its mark on the raw side of a piece of waste leather. A little practice will enable the workman to judge of the heat. The tool is now to be pressed downwards, on the gold leaf; which will, of course, be indented, and show the figure imprinted on it. The next letter, or stamp, is now to be taken, and stamped in like manner, and so on with the others; taking care to keep the letters in an even line with each other, like those in a book. By this operation, the resin is melted; consequently, the gold adheres to the leather: the superfluous gold may then be rubbed off by a cloth; the gilded impressions remaining on the leather. In this, as in every other operation, adroitness is acquired by practice.

The cloth alluded to, should be slightly greasy, to retain the gold wiped off; (otherwise there will be a great waste in a few months,) the cloth will thus be soon completely saturated, or loaded with the gold. When this is the case, these cloths are generally sold to the refiners, who burn them, and recover the gold. Some of these afford so much gold by burning, as to be worth from a guinea, to a guinea and a half.

To gild Writings, Drawings, &c. on Paper or Parchment.—Letters written on vellum or paper, are gilded in three ways: in the first, a little size is mixed with the ink, and the letters are written as usual; when they are dry, a slight degree of stickiness is produced by breathing on them, upon which the gold leaf is immediately applied, and by a little pressure, may be made to adhere with sufficient firmness. In the second method, some white lead or chalk is ground up with strong size, and the letters are made with this, by means of a brush: when the mixture is almost dry, the gold leaf may be laid on, and afterwards burnished. The last method is, to mix up some gold powder with size, and to form the letters of this, by means of a brush. It is supposed, that this latter method, was that used by the monks in illuminating their missals, psalters, and rubrics.

To gild the edges of Paper.—The edges of the leaves of books and letter paper, are gilded, whilst in a horizontal position, in the bookbinder's press, by first applying a composition formed of four parts of Armenian bole, and one of candied sugar, ground together with water, to a proper consistence, and laid on by a brush, with the white of an egg. This coating, when nearly dry, is smoothed by the burnisher; which is generally a crooked piece of agate, very smooth, and fixed in a handle. It is then slightly moistened by a sponge, dipped in clean water, and squeezed in the hand. The gold leaf is now taken up on a piece of cotton, from the leathern cushion, and applied on the moistened surface. When dry, it is to be burnished by rubbing the agate over it, repeatedly, from end to end, taking care not to wound the surface by the point of the burnisher. A piece of silk or India paper, is usually interposed between the gold and the burnisher.

Cotton wool is generally used by bookbinders, to take the leaf up from the cushion; being the best adapted for the purpose, on account of its pliability, smoothness, softness, and slight moistness.

[TO BE CONTINUED.]

On the Superiority of the Straw-Paper, made by Mr. Louis Lambert's new patent process, over that formerly made by Mr. Matthias Koops.

Mr. Koops took out a patent for making paper from straw, upwards of twenty years since; the manufactory was first established at the Neckinger Mill, at Bermondsey; and afterwards removed to the Thames Bank, Chelsea, where it terminated unsuccessfully.

We cannot wonder at this failure, when we consider that his process consisted in merely steeping the straw, previously cut into pieces of about two inches long, in *cold* lime-water, and afterwards subjecting it to the *cutting* action of the paper mill; and the produce, after all, was a harsh, coloured paper; which never came into general use.

Mr. Lambert, on the contrary, merely frees his straw from the knots, and then submits it to *ebullition*, either with quicklime in water, or with caustic potash, soda, or ammonia, in order to extract the colouring matters, and dispose it to become fibrous; he then washes it, and next exposes it to the action of a hydro-sulphuret, composed of quicklime and sulphur in solution, in proper proportions of the quicklime, sulphur, and water (as indicated in the specification of his patent, published in page 92 of this Journal,) in order to free it from the mucilaginous and *silicious* matters, so prejudicial in paper making. He then washes it thoroughly, in successive portions of water, by exposing it to the *beating* (not *cutting*) action of the paper mill, till all smell of the alkaline sulphuret is entirely removed; he then presses it, and afterwards submits it to the usual operations employed in bleaching vegetable fibres, viz. to the action of chlorine, either separate, or in combination with lime; or by exposure to the open air and light, upon the grass. It is, lastly, exposed to the action of the rag engines usually employed in paper making, in order to reduce it into paste or pulp, previous to being made into paper.

The produce of this superior process, is a *soft white pulp*, fit for making *fine paper*, and very different indeed from the *harsh, coloured paper*, made under Mr. Koops' patent. [*Tech. Rep.*

A Process to render Cloth and Silk Water Proof. By M. COLLET.

The silk, or cloth, must be spread upon a wooden frame, and immersed or soaked with the following mixture: linseed oil, one pound, white lead, one ounce and a half, umber, one ounce, and a clove of garlic. The whole of these ingredients must boil for twelve hours,

on a small fire, and when the composition is perfectly fit for use, the surface will put on the appearance of skin.

The cloth, after having been immersed in, or washed with this composition, is to be hung up to dry, and when that is effected, to be rubbed with pumice stone to render it smooth. It is then to be coated with another thick fluid, composed of linseed oil, one pound, vitreous oxide of lead, one ounce, sulphate of zinc, four drams, and white lead, calcined till it has changed yellow, four ounces. These must be previously boiled together in an iron pot, until the material have the consistence of paste; the composition is then to be spread equally over the right side of the cloth; the material is then dried upon the fabric, in a chamber heated to forty or fifty degrees; it is necessary to repeat the operation twice for silk, and the result will be the production of an oil skin cloth, which will be water proof, and not rub nor wash off.

RAPID DISTILLATION.

Professor Oersted has pointed out a method of considerable utility in the evaporation of liquids. He fastens together a great number of fine metallic rods or wires, and puts them in the bottom of the still, or evaporating vessel, and by this means he distils seven measures of brandy with the same fuel, which, without the rods, would distil only four.

MOREY'S NEW VAPOUR ENGINE.

Samuel Morey, Esq. a gentleman whose name is familiar to those who have devoted their attention to mechanical science, has obtained a patent for a vapour engine, which, in the opinion of competent judges, promises to answer well, in practice. The vacuum in the cylinder, is produced, by firing an explosive mixture of atmospheric air, and vapour from common proof spirits, mixed with a small portion of spirits of turpentine. A working model has been set in motion, and kept at work, without elevating the temperature of the fluid, from which the vapour is produced, to a higher degree than that of blood heat. Should no unforeseen difficulties present themselves, in its operation on a large scale, it will be the greatest improvement which has been made for many years, particularly in its application to locomotive engines; as the weight of the materials required, to keep it in action for a considerable length of time, will be so small, as not to be worth mentioning.

A gentleman has gone to England, for the purpose of obtaining a patent in that country.

BORING FOR WATER.

Mr. Disbrow, who has been for some time engaged in boring for water, on the land of Mr. John H. Bostwick, in the neighbourhood of

New Brunswick, in the state of Jersey, has met with complete success. Before inserting a tube, the water rose to the height of about two feet above the surface; since the orifice has been so secured, it rises to the height of six feet, and would, if necessary, ascend still higher.

The discharge, at six feet above the ground, is about a gallon and a half, per minute; and at half that height, the quantity is doubled. The depth bored, was from 240 to 250 feet. This, we understand, is the fourth instance, in which this gentleman has succeeded in obtaining water, in the same neighbourhood. We hope that Mr. Disbrow, or some other person acquainted with the whole procedure, will furnish particulars on this interesting subject, either through the medium of this Journal, or in some other way, in which they may be made public.

AMERICAN TYPOGRAPHY AND ENGRAVING.

The following notice of the state of these arts in the United States, is translated from the volume of the *Revue Encyclopédique*, for Jan. 1826; a work of high literary merit and reputation, published in Paris.

"American Ornithology, by *Charles Lucien Bonaparte*. This work is the most remarkable which has issued from the American press, for the richness both of its typography and engravings; and is, perhaps, not inferior in either of these particulars, to any work of a similar kind, which has been printed in Europe."

This remark, as liberal as it is just, derives no small value, from the circumstance of its having been made in a city, where these arts have attained a high degree of perfection, and by those who are competent to pronounce a correct opinion.

FRANKLIN INSTITUTE.

Philadelphia, April 20, 1826.

The ninth quarterly meeting of the Franklin Institute, was held at the new Hall—the President in the chair, and S. V. Merrick was appointed Secretary.

The following Report was received from the Board of Managers, adopted, and ordered to be printed. Adjourned,

S. V. Merrick, Secretary.

To the Franklin Institute, of the State of Pennsylvania, the board of managers respectfully present the following report of their proceedings during the quarter which has just expired.

The first meeting of the board, after the annual election, was held on the 21st of January, when the board was organized, and Thomas Fletcher was chosen chairman, and John R. Warder, Clerk, for the current year.

The building of the hall has advanced with rapidity, and is expect-

ed to be completed in two months. The District Court of the United States have taken possession of their apartments; and the board have held their meetings in one of the rooms, since the beginning of March.

The lectures of the season, have been brought to a close. Three regular courses were given—one on Chemistry, by Mr. Keating, one on Mechanics, by Dr. Jones, and one on Natural History, by Dr. Godman. Besides these, however, many lectures were delivered by different members of the Institute. Before the arrival of Dr. Jones, Dr. Patterson volunteered to supply his place, and gave lectures on the strength, and stress of timbers. Mr. P. A. Browne gave lectures on the law of apprentice and master; Dr. Griffith on the diseases incident to mechanics and manufacturers; Dr. Darrach on the mechanism of the human frame; and, at the close of the season, Dr. Hare gave at his own room, lectures on electricity.

The audience at the lectures, was always numerous and attentive, and it is believed that this important and prominent department of the Institute, has not failed to prove eminently useful.

Still, it must be universally acknowledged, that to receive the full advantage of a course of lectures, requires a degree of preparatory instruction, and a maturity of age, which many of our auditors do not possess. The great and fundamental object for which we were established, namely, to improve the condition and elevate the character of the operative class of society, by affording them the only effectual means for this purpose, *education*, cannot be accomplished by lectures alone. To attain this object effectually, we must commence at an early age, and it should be our aim to give to the children of our mechanics and manufacturers, who are generally in but moderate circumstances, the advantages of education which have hitherto been confined to the children of the rich, and which have ever constituted the choicest boon that wealth could purchase for them.

Impressed with these views, the Board established, nearly two years ago, a school for mathematics, and one for drawing. But the schools are insulated, and do not constitute, as they ought, parts of a complete system of elementary education; and they have failed, from this cause, and, it is believed, from this cause alone, to fulfil the expectations which were formed at their commencement.

At present the necessity of adopting a more enlarged and perfect plan of education, in the Institute, seems to be universally felt; and accordingly at the meeting of the Board of the 6th of April, it was unanimously resolved, that it was expedient to extend the system of education according to the general outline of a plan reported by the Committee of Instruction; one of the leading features of which, is the establishment of a High School Department, in which the system of mutual instruction shall be introduced, and in which the elements of mathematics, drawing, geography, history, the Latin and Greek languages, and, when practicable, the French and Spanish, shall be taught.

As the details of this plan have not been fully digested and arranged, it is thought that it would be premature, at this time, to bring it more fully before the institute.

We have the satisfaction to state that the "Franklin Journal," to which, allusion has been made in our former reports, has been at length commenced, under the most favourable auspices. It is under the patronage of the Institute, but the editorship is entirely committed to the Professor of Mechanics, Dr. Thomas P. Jones. The first number was published in the month of January, and two other numbers have since appeared. It has hitherto given entire satisfaction to the Board, and it is believed to the members of the Institute, and the subscribers, generally. We sincerely hope that it may receive the continued, and increasing encouragement, which it so richly merits.

The Board, after much deliberation, have deemed it expedient to alter the time for the payment of the annual contributions, and have adopted the following resolutions, which they think it right to communicate to the Institute.

Resolved, That the annual payments from members of the Institute be hereafter due and payable on the third Thursday of October in each year.

Resolved, That on the third Thursday of October, the Treasurer be authorized to issue the tickets of those members who have already paid their subscription for 1826, upon the payment of one dollar and fifty cents, the ticket then issued to be current for one year thereafter.

Resolved, That the Treasurer be authorized to receive from all members who have not paid their subscription for 1826, and from all members who may be elected prior to 1st October, 1826, one dollar and fifty cents, being for a half year's subscription to that date, and for which he shall issue receipts.

Since the last quarterly report, forty new members have been added to the Institute.

The Treasurer's report herewith presented, exhibits the state of the funds of the Institute for the quarter just expired, by which it will be seen that 111 dollars and 50 cents have been received for life memberships, and 1158 dollars for annual contributions.

The whole amount received during the quarter was 3261 dollars and 1 cent, and the expenditures, including six months interest on the building loan, amounted to 2683 dollars and 74 cents; leaving a balance in the hands of the Treasurer, of 577 dollars and 27 cents.

All which is respectfully submitted.

By order, THOS. FLETCHER, Chairman.

Attest—

JNO. R. WARDER, Clerk of the Board.

Philadelphia, 20th April, 1826.

List of New Patents in England, which have passed the Great Seal, since Dec. 27, 1825.

To John M'Curdy, Esq. for certain improvements in generating steam. Dated Dec. 27, 1825.—To be specified in six months.

To James Oyston, and James Thomas Bell, watchmakers; who, in

consequence of a communication made to them, by a certain foreigner, residing abroad, are in possession of certain improvements, in the construction or manufacture of watches, of different descriptions. Dated Jan. 6, 1826.

To Richard Evans, coffee-merchant; for certain improvements in the apparatus for, and process of distillation. Dated Jan. 7, 1826.—In six months.

To Henry Houldsworth, jun. of Manchester, cotton-spinner; for certain improvements in machinery, for giving the taking up, on winding—on motion, to spools, or bobbins, and tubes, or other instruments, on which the roving or thread is wound, in roving, spinning, and twisting machines. Dated Jan. 16, 1826.

To Benjamin Newmarch, Esq.; for an improved method of exploding fire-arms. Dated Jan. 16, 1826.—In six months.

To John Rothwell, of Manchester, tape manufacturer; for an improved heald, or harness, for weaving. Dated Jan. 16, 1826.—In two months.

To Henry Anthony Koymans, merchant; who, in consequence of certain communications made to him, by a certain foreigner, residing abroad, is in possession of certain improvements in the construction and use of apparatus, and works, for inland navigation. Dated Jan. 16, 1826.—In six months.

To John Frederick Smith, Esq.; for an improvement in the process of drawing, roving, spinning, and doubling wool, cotton, and other fibrous substances. Dated Jan. 19, 1826.—In six months.

To William Whitfield, of Birmingham, for certain improvements in making or manufacturing of handles for saucepans, kettles, and other culinary vessels, and also tea kettle handle straps, and other articles. Dated Jan. 17, 1826.—In six months.

To Benjamin Cook, of Birmingham, for certain improvements in making or constructing hinges, of various descriptions. Dated Jan. 19, 1826.—In six months.

To Abraham Robert Corent, of Gottenburgh, in the kingdom of Sweden, merchant; at present residing in the city of London; for a method of applying steam, without pressure, to pans, boilers, coppers, stills, pipes, and machinery, in order to produce, transmit, and regulate various temperatures of heat, in the several processes of boiling, distilling, evaporating, inspissating, drying, and warming; and also to produce power. Dated Jan. 19, 1826.—In six months.

To Sir Robert Seppings, Knight, a commissioner and surveyor of our navy, of Somerset House, in the county of Middlesex; for an improved construction of such masts and bowsprits as are generally known by the names of made masts, and made bowsprits. Dated Jan. 19, 1826.—In two months.

To Robert Stephenson, engineer; for his axletrees to remedy the extra friction on curves to wagons, carts, cars, and carriages, used, or to be used, on rail-roads, railways, and other public roads. Dated Jan. 23, 1826.—In six months.

Erratum—in page 158, line 7; for weights, read heights.

THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE MECHANIC ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

MAY, 1826.

In page 192 of this Journal, we gave notice of our intention to publish the subjoined paper, and spoke of it in such terms, as we are well assured its perusal will justify. It was then in the hands of the Editor; but the publication of it was deferred, as it was wished, by several gentlemen, who knew its value, that it might first be presented to the American Philosophical Society, which has been done. It was read on the 7th of April, and received the unqualified approbation of that body. It has been already printed by the Society, and will appear in their Transactions.

It was the intention of the Editor, to make an abstract of the paper; but as it will, in the first instance, become generally known through the medium of this Journal, the author was unwilling that it should appear in an abridged form. With the exception, therefore, of some observations upon charcoal; and upon the law which obtains, in the cooling of heated bodies, the whole is now published. The parts omitted, will form separate papers, and appear in our next number.

Experiments to determine the comparative quantities of Heat, evolved in the combustion of the principal varieties of Wood and Coal, used in the United States, for Fuel; and, also, to determine the comparative quantities of Heat lost by the ordinary apparatus, made use of for their combustion. By MARCUS BULL.

The experiments on fuel, detailed in the following paper, were commenced in November, 1823, and were prosecuted, with very little cessation, until June, 1824; when, in consequence of absence, together with subsequent ill health, they were suspended until May, 1825, when they were again resumed, with undiminished interest, and have been continued, as circumstances would permit, until the present time.

During the latter of these periods, I was under the necessity of

repeating the experiments which had been previously made, in consequence of a defect discovered in a part of the apparatus, the removal of which, was found to change the results; still, it was very satisfactory to find that the variation was, in every instance, directly proportional to the results which had been formerly obtained.

The experiments to determine the comparative loss of heat sustained, by using apparatus of different constructions, for the combustion of fuel, appeared to be equally necessary with those to determine its comparative efficiency.

To Professors Hare and Patterson, of the University of Pennsylvania, I am under obligations, for their kind assistance in my experiments; and it gives me great pleasure to have an opportunity, thus publicly, to tender them my acknowledgments.

The importance of those experiments, which have for their object the promotion of the useful arts and sciences, or an improvement in the domestic economy of society, by which our comforts may be increased, is generally admitted.

In a climate like that of the United States, where, during two-thirds of the year, fires are indispensable to human comfort, and where, consequently, the savings of a large portion of the poor, during the summer, are often inadequate to purchase a sufficient supply of fuel for the winter, it must, obviously, be highly important to ascertain, the comparative efficiency of different kinds of fuel; as, without this knowledge, those who are desirous of economising, may be prodigal through ignorance.

The knowledge of the comparative heat disengaged in the combustion of the different varieties of wood and coal, is also important in various processes in the arts; and it is believed that the results of my experiments, will be found worthy of attention, in a philosophical point of view.

Previously to describing my apparatus or experiments, it will be proper to notice those of some of my predecessors, as, in the investigation of this subject, no small degree of inaccuracy appears to have prevailed, even among experimenters of high character.

My remarks cannot be better prefaced, than by making use of the following extract from Dr. Ure, on the subject of combustion.

"Lavoisier, Crawford, Dalton, and Rumford, in succession, made experiments to determine the quantity of heat evolved in the combustion of various bodies. The apparatus used by the last was perfectly simple, and, perhaps, the most precise of the whole. The heat was conducted by flattened pipes of metal, into the heart of a body of water, and was measured by the temperature imparted."

From the general table of results, it is only necessary for me to extract two, to show the force of the succeeding remark.

Substances burned, one pound.	Ice melted, in pounds.			
	Lavoisier	Crawford.	Dalton.	Rumford.
Olive oil.	149	89	104	94.07
Charcoal.	96.5	69	40	

"The discrepancies in the preceding table, are sufficient to show the necessity of new experiments on the subject."

As the experiments of M. Lavoisier, Dr. Crawford, and Mr. Dalton, did not comprise any article of fuel excepting charcoal, a more particular notice of them would be irrelevant to my purpose.

The experiments of Count Rumford, to determine the quantity of heat evolved in the combustion of different woods, will alone be examined. In his very just remarks, he says: "Many persons have already endeavoured to determine the relative quantities of heat furnished by wood and charcoal, in their combustion; but the results of their inquiries have not been satisfactory.

Their apparatus has been too imperfect, not to leave vast incertitude in the conclusions drawn from their investigations. Indeed, the subject is so intricate in itself, that with the best instruments, the utmost care is requisite, lest, after much labour, the inquirer should be forced to content himself with approximations, instead of accurate results, and valuations, strictly determined.

All woods contain much moisture, even when apparently very dry; and, as the persons alluded to, have neglected to determine the quantities of absolutely dry wood, burned by them, much uncertainty prevails in the results of all their experiments. Another source of uncertainty, lies in the great quantity of heat suffered to escape with the smoke, and other products of the combustion."* Again,† "attempts have been long ago made, to measure the heat that is developed in the combustion of inflammable substances; but the results of the experiments have been so contradictory, and the methods employed so little calculated to inspire confidence, that the undertaking is justly considered as very little advanced. I had attempted it at three different times within these twenty years, but without success. After having made a great number of experiments with the most scrupulous care, with apparatus on which I had long reflected, and afterwards caused to be executed by skilful workmen, I had found nothing, however, that appeared to me sufficiently decisive, to deserve to be made public. A large apparatus in copper, more than twelve feet long, which I had made at Munich fifteen years ago, and another, scarcely less expensive, made at Paris four years ago, which I have still in my laboratory, attest the desire I have long entertained, of finding the means of elucidating a question that has always appeared to me of great importance, both with regard to the sciences, and to the arts. At length, however, I have the satisfaction of announcing to the class, that, after all my fruitless attempts, I have discovered a very simple method of measuring the heat manifested in combustion, and, this even with such precision, as leaves nothing to be desired."

It will not be necessary to describe the *Calorimeter* used by Count Rumford, more particularly, than to say, that it consists of a small copper receiver containing water. In the inside is a flat worm, also made of copper, bent so as to pass horizontally three times from one

* Nicholson's Journal, XXXV. 105.

† Ibid. XXXII. 105.

end of the receiver, to the other. This worm passes down through an aperture in the bottom, near one end of the receiver, to which it is soldered; and the other extremity of the worm, passes through the opposite end of the receiver. A thermometer is introduced into the water contained in the receiver; the woods, in thick shavings, and other combustible bodies, are consumed in the mouth or bottom of the worm, and the heat evolved in the combustion, is imparted to the water, during its passage through the worm.

The experiments consisted in elevating the temperature of the water in the receiver 10°, commencing at 5° below, and finishing at 5° above the temperature of the room; and the comparison was made between the weights of different articles required to be consumed to produce this effect, *without regard to time.*

The quantity of wood consumed, varied from 59 to 111 grains, in each experiment.

Upon these experiments it is necessary to remark, that the passage of the mercury, from 1 to 10° on the scale of the thermometer, can scarcely be supposed to have been performed, in all the experiments, *in equal periods of time;* and, since the water would require unequal increments of heat in equal times, to counterbalance its unequal decrements, and, possessing, as it does, different capacities for heat at different temperatures, consequently, a very slight inequality in point of time, in elevating the mercury between the several degrees, would materially affect the results of experiments, in which only a few grains of combustible were consumed.

To these causes, and the absence of proper means to take advantage of the heat, produced in the combustion of the carbon contained in the woods, may be attributed the inaccuracy of Count Rumford's results; as he states some of the woods to evolve, by the combustion of equal weights, 64 per cent. more heat than others; whereas, the results of my experiments, on forty-six varieties of wood, in equal weights, give the extremes of difference as only 11 per cent.

The result from charcoal is not given in the table, but the Count says, that "The dry vegetable flesh of wood, produces more heat in its combustion, than an equal weight of dry charcoal."*

By the expression "dry vegetable flesh," the Count means to indicate that portion of dry wood which is inflammable, or that part which is independent of the charcoal. Now I find, by the most favourable comparison, for this portion of the wood, that an equal weight of dry charcoal, produces 286 per cent. more heat than the former; and by the least favourable comparison, 314 per cent. more, giving a mean difference of 300 per cent. in favour of the charcoal.

It will be proper to state, what have been considered as essential requisites to the perfection of the apparatus, that, as the description proceeds, the degree of accuracy which it is likely to possess, may, with greater facility be determined; and this will be done under three heads, with explanatory remarks.

1st. *That the apparatus in which the combustion is produced, be so*

* Nicholson's Journal, XXXV. 112.

constructed, that all, or an equal proportion of all the heat generated, may be measured by some unchanging standard.

This is effected in a manner to be hereafter more particularly described, but it may now be sufficiently understood, by referring to the plate, in which the apparatus, and the interior of the room, constructed for performing the experiments, are shown in perspective. At E is a thermometer, the bulb of which is in the centre of the stove-pipe, and another, Fig. 6, is suspended from the side wall of the room.

When articles are submitted to combustion in the stove, the heat is so completely given out by the pipe, that these two thermometers, indicate, *exactly*, the same degree of temperature.

Strictly speaking, we cannot say, even in this case, that *all* the heat generated, is imparted to the air of the room. That small portion which is included in the air of the pipe, and passes off into the chimney, does not impart its heat to the air of the room, both being of the same temperature, consequently, no interchange of heat can take place between them. We may consider this escape of heat, however, in the same point of light, as we do that which is conducted off by the surface of every other part of the room, with this difference—that *this particular surface of two inches diameter, conveys more heat in a given time, than any other equal surface;* but, as this difference is uniform in all the experiments, we may say, *comparatively*, that there is *no loss* of heat, as it is the *ratio*, and not the *positive* quantity of heat disengaged, which we wish to discover.

2nd. *That the recipient body be always affected equally, by the communication of the same heat.*

Air has been selected as the recipient body, because we are enabled by a thermometer to measure with accuracy, the heat communicated to it; and because it varies very little in its specific heat, under the ordinary changes of barometric pressure, and its hygrometric changes may be readily counteracted.

3d. *That the surrounding refrigerating medium be permanent at any required temperature.*

In consequence of the variations in the temperature of the atmosphere, not only daily, but in different parts of the same day, to devise a plan which should strictly comply with this requisition, was a subject which caused me much reflection and perplexity. The room selected for my experiments, was well calculated, in every respect, (except the window,) to prevent an immediate influence being produced in its temperature, by the ordinary external changes. The window being large, I determined to close it entirely, and to perform my experiments by lamp light; and it was, accordingly, perfectly closed on the inside of the room, with boards, which were well seasoned, and grooved together, leaving a space of four inches between this barricade, and the sashes of the window. This space being occupied with *confined air*, was a bad conductor of heat. Finding it inconvenient, and objectionable in other respects, to experiment with artificial light, a sash with four panes of glass was subsequently inserted in this barricade, for the admission of light. Every part of the room was then

made as tight as possible, and to furnish it with the necessary supply of air, of equal temperature, a pipe with a valve was inserted through a partition, into an adjoining room, the temperature of which was necessarily maintained very uniform, for the purposes to which it was applied. Having spent nearly four months of application in perfecting my apparatus, and removing difficulties which presented themselves at the threshold of every stage of the investigation, and feeling desirous to avail myself of any improvements which might be suggested to me, either in the apparatus, or the intended plan of conducting the experiments, I invited several gentlemen to examine it for that purpose, and among them Dr. Hare, professor of chemistry in the University of Pennsylvania.

The method which had been adopted, as described, to comply with the last requisition, did not appear to Dr. Hare to possess that degree of accuracy which was necessary; nor did it equal that which every other part of the apparatus, together with the intended plan of conducting the experiments, as described to him, appeared to possess. Dr. Hare stated to me, that, "he had long been under the impression, that no accurate comparison could be made by means of the same single room, heated at different times, with different fuel, on account of the varying temperature of the weather; nor by different rooms, at the same time, from the difficulty of finding two rooms sufficiently alike, in form, aspect, size, and materials. It seemed to him indispensable, to have one room within another, so that, in the interval, a uniformity of temperature might be artificially sustained." As the method suggested by Dr. Hare, would remove a difficulty with which I had unsuccessfully contended, no time was lost in making a practical application of his suggestion, and a room of smaller dimensions was in consequence constructed within that originally intended for my experiments, in the best manner which my architect could devise; by which a free circulation of air is produced on all the exterior surfaces of the interior room, and this air may be sustained of a uniform temperature.

A description of the apparatus, plan of the experiments, and the manner of experimenting, will now be detailed.

In a room with a floor of about eleven feet by fourteen, and nine and a half feet in height, another room is constructed, eight feet square in the clear, its contents being 512 cubic feet. The plate represents the interior of this room in perspective, and as these rooms may now be considered as distinct, I shall, for convenience, designate them by the names of *interior* and *exterior*.

The frame of the interior room is composed of scantling, three inches by four. The ends of the posts, and the top and bottom rails, have mortises, with tenons passing through them, of sufficient length to project about four inches, and, in the projecting part of the tenons, are transverse mortises for wedges, by which the frame is drawn firmly together. The floor is supported by two cross pieces of scantling, and the posts and rails are grooved through the centre, to receive boards one inch in the clear, with which the room is enclosed. The boards are also grooved together in the most

perfect manner, so that the wedges (there being no nails used excepting about the door and window) will draw every part of the room tight, and correct, with great facility, any shrinking of the boards during the process of seasoning, which it was necessary to perfect, previous to any experiments being made.

The interior is supported by its four posts, six inches from the floor of the exterior room, there being the same distance between the ceilings, and a much greater between the side walls, the air therefore circulates freely between the two rooms. The internal surfaces of the interior room, are made as white as possible with lime-wash, to produce equality in their power of conducting heat. The body of the stove, Fig. 1, is a cylinder, twelve inches in height, and four inches in diameter; the ash pit is four inches deep, and four inches in diameter; both are made of common sheet iron, and separate, for the purpose of introducing between them, a chamber, or concave piece of sheet iron, of larger dimensions, perforated with holes half an inch in diameter; and on this chamber the body of the stove rests, as will be seen, by referring to the enlarged sectional view on the plate, Fig. 2. Three inches above this chamber is another, closely fitted within the body of the stove, and perforated with holes one quarter of an inch in diameter. The interior of the body of the stove above, is made to assume the conical shape which it presents, with the apex downwards, by coating it with fire clay, so as to expose only one and a half inches diameter of the surface of the chamber, and on which the fuel rests. The space between the chambers is necessary in experimenting on anthracite coals in small quantities, for the purpose of heating the air as much as possible before it comes in contact with the burning body, and the clay coating is also necessary in the same experiments, to act as a non-conductor. The stove, Fig. 1, is supplied with air through apertures just above the ash pit, or lower door, and to lessen, or close these apertures, a sliding sheet iron hoop, (not shown in the engraving,) is fitted with great accuracy. The middle door is necessary, to obtain access to the upper chamber when its apertures require clearing, during an experiment. For heating water, a tin vessel in the shape of a crescent, rests on cleats, between the upper and middle doors. This vessel is accurately fitted to the body of the stove, but may be removed to any required distance, at pleasure; and we may thereby lessen the evaporation of the water, its object being to regulate the hygrometric state of the air.

All the doors of the stove are represented as open. The upper door is to admit the fuel. The cone, leading from the body of the stove to the pipe, is ten inches long, and very accurately fitted to the former, but removeable for the purpose of separating them, to take from the stove and ash pit, the unconsumed parts of any body, that may have been experimented upon. This is done with facility, as the pipe is supported from the ceiling, by wires which sustain it in its place, after the body of the stove is removed.

In the cone, three quarters of an inch above its junction with the body of the stove, (which in this place is made flat,) is an aperture

one inch broad, and one and a quarter inches long, which is covered with a thin plate of mica, resting on a flange, or ledge, and kept in its place by a wire passing round the cone. Through this plate of mica, the fire may be seen, thereby avoiding the necessity of opening the upper door for the purpose of examination.

The pipe is two inches diameter, and made of extra thin *black* tin, to impart the heat to the air of the room with the least possible obstruction. The elbow joints are each nine inches long. The whole length of the pipe is forty-two feet; and this was found insufficient to impart to the air of the room all the heat generated, there being a loss of 3°, until the tin box, A, was attached to the pipe near its extremity. This box is fourteen inches long, ten inches broad, and $\frac{3}{8}$ths of an inch deep, and its interior and exterior surfaces are made black. In passing through this box, the warm air is exposed to a much larger surface than that presented by the pipe, and the few degrees of heat which it before contained, are by this means imparted to the air of the room.

The joints of the pipe are perfectly closed by clay lute, and its whole exterior surface is covered with a thin coat of dead black varnish, made to resist heat.

The valves B, C, D, to regulate the admission of air into the stove, are all of the same construction, being circular pieces of flat thick sheet iron, very accurately adjusted, to close the interior of the pipe. Fig. 3, represents a side view of the valve B, standing entirely open. The wire to which it is firmly riveted, crosses the centre of the valve, and passes through the pipe. This end of the wire serves as one of the pivots for the valve to turn upon, and the other end, being bent into a half circle, is used both as a handle to turn the valve, and as an index to regulate it. The point of this enters the graduated holes in the dial; Fig. 4, which is a front view, and is riveted to the exterior of the pipe, being the half of a circle of flat sheet iron, whose whole diameter is equal to that of the pipe. The handle is bent to correspond exactly with the flat surface of the valve, by which the situation of the handle indicates the position of the valve inside of the pipe, so that no mistake can occur in its use.

Being well aware that the experiments could not be accurately performed, unless the operator should at all times possess a perfect control over the burning body; it became necessary after attaching the box A, to insert the cross pipe with the valve D, by which the current of air through the stove may, in an instant, be placed at its maximum in quantity and velocity, if permitted to pass through this cross pipe, in place of passing through the shallow box A.

This passage is useful when igniting anthracite coal, in which process, the coal, as well as all other combustible bodies, require to be heated to a certain temperature before they will ignite, during which process, heat being absorbed, and not disengaged, if care be taken to close this valve in proper time, none is lost. As this required temperature differs not only in different bodies, and in the different component parts of some bodies, but is specific, for each, it may for convenience, be termed their *heat of ignition* or *accension.*

This passage is also useful in some experiments, to give a momentary impulse to the inflammation, of certain bodies, and cannot be dispensed with, without great loss of time in heating the room to its proper temperature, before commencing an experiment.

Considerable difficulty was experienced in getting the valves, and their appendages, made with sufficient accuracy; but when done, as half of the arc of each dial is divided into twenty equal parts, it will be perceived that the current of air to supply the body in combustion, can be regulated with great precision.

The valve B, is particularly useful, to stop at a proper time the combustion of those bodies, which it is known cannot be wholly consumed in the stove; and this is done almost instantaneously, by closing this valve, and sliding down the hoop which covers the apertures for the admission of air.

The pipe passes through the side wall, into the chimney of the exterior room. Near the end of the pipe, within the interior room, is an aperture of sufficient size to admit the bulb of the thermometer E, and this aperture is closed by a tin plate closely fitted to the stem of the thermometer. This plate is curved to fit the pipe, and is of sufficient size to cover the aperture, and rest upon the pipe. The bulb of the thermometer is suspended in the centre of the pipe, by the brass scale being made shorter than usual, and resting on the tin plate, which is secured in its place by a small quantity of clay lute. This thermometer is used to measure the temperature of the air within the pipe, previous to its passing into the chimney; and as I have never found the bulb discoloured by the carbonaceous particles in the smoke, and thereby rendered more sensible, as it was feared would be the case, I am induced to think very little ever reaches it, being previously deposited in the pipe.

Fig. 6, is another mercurial thermometer, suspended from the side wall of the room. Both these were made expressly for my experiments, and to correspond in their scales (which are Fahrenheit's) with the greatest possible accuracy. The thermometer, Fig. 6, is used to measure the temperature of the air in the room, and is placed on a line with that in the pipe, at twelve inches distance. The bulb is screened by a piece of bright planished tin, to prevent the influence of heat radiated from any part of the stove or pipe, while it does not prevent a free access of the air in the room, to the bulb of the thermometer.

Fig. 7, is Mr. Leslie's differential thermometer, one half of which is passed through an aperture in the board partition into the exterior room, and is secured in its place by a divided cork, which encircles a part of the syphon at the bottom of the instrument, and closes the aperture. Both bulbs are perfectly screened by large pieces of bright planished tin, not shown in the engraving. This instrument, as its name denotes, measures only the *difference* of temperature in the two rooms, and as it does this with peculiar delicacy, it is admirably adapted to my purpose, the accuracy of my experiments depending in a great measure on the uniform difference of temperature in the two rooms; and I am under obligations to its inventor, and also to

Dr. Hare, as it was in consequence of the suggestion of the latter gentleman, that this instrument was added to my apparatus; its peculiar applicability to my experiments not having previously occurred to me.

The differential thermometer used in my experiments, indicated 20°, to 1° of the mercurial thermometers, and, as one of the bulbs is situated in the interior room, it can only be operated upon by the temperature of that room; the other bulb being in the exterior room, can only be operated upon by the temperature of the latter room; consequently, any change of temperature in either, will be shown on the scale, the instrument having been adjusted with great care, so that the top of the tinged liquor will stand at 50°, when there is a difference of 10° between the mercurial thermometers placed in the two rooms; and from its superior sensibility in detecting incipient changes, the differential thermometer may almost be said to possess the power of *divination*, whereby the operator receives timely notice to avoid any essential error.

Fig. 5, is a tin supply pipe, two inches in diameter. This passes through the floor in a perpendicular direction, and has an elbow joint opening towards the stove. It has a valve to regulate the quantity of air found necessary to be admitted into the room for the purposes of respiration, and to support the combustion in the stove. This valve, when once adjusted, remained the same through all the experiments. Whether the precise quantity of air necessary for the respiration of the operator, and to support the combustion, is admitted by this pipe, *or an excess*, its temperature being the same, and the stove being supposed always to be supplied with air at the temperature of the interior room, and to require about the same quantity during any given period of two or more experiments, the air admitted being also of equal volume, its velocity will be the same under all changes of barometric pressure; consequently, the reduction of the temperature of the air in the room may be supposed to be the same during the time required to perform each experiment, with the exception of an immaterial variation in its specific heat, to be hereafter noticed; and, the results of the experiments cannot be affected by the admission of an excess of air, they being, as before stated, founded on the comparative, and not the positive quantity of heat evolved.

At Fig. 8, is a hygrometer made of the beard of the wild oat, enclosed in a small brass case, and covered with glass. This is used to measure the humidity of the air, which, like all other bodies, possesses different conducting powers as its hygrometric state varies, by which its specific heat, or capacity for absorbing caloric, is increased or diminished; those bodies which contain moisture, being better conductors, than the same bodies, when dry. The comparative capacities of water, and dry air, are, as 1.000 to .266, by the experiments of MM. Delaroche and Berard. From Sausseur's experiments, it appears, however, that the quantity of aqueous vapour attracted by the air of the atmosphere, when at 65° of Fahrenheit, is very small; a cubic foot of air requiring not more than eleven or twelve grains, to bring it from the state of perfect dryness, to that of extreme moisture.

Now, as the various sides of the room are the conducting media by which the heat, generated in the room, is dissipated, and as these sides are in contact with the air of the room, and must in some degree be influenced by its hygrometric state, they will consequently, become more or less powerful conductors, as this varies. To produce a uniformity in this respect, I have, by the aid of this instrument, and of the water contained in the tin vessel before described, taken care to keep the air of the interior room, in the same hygrometric state, during the various experiments.

The barometer at Fig. 9, requires no description, and is not considered an essential appendage to my apparatus, although convenient as a check upon the valves; not, however, on the common supposition that the velocity of the current of air through the stove is greater under one pressure than another, *cæteris paribus*, but that its quantity varies with its density; more being contained in the same volume at one pressure, than at another.

The results of MM. Clement and Desormes' experiments on gases, to determine their *specific heats*, at different densities, show that the specific heat of atmospheric air, does not vary more than .02, between 29.5 and 30.5 inches of barometric pressure. These being the extremes during my experiments, the difference of heat required to maintain the temperature of the air between any two experiments, cannot materially affect their results, and for this variation no correction has been thought necessary.

Having described the construction of the interior room, and its apparatus, it remains to describe the exterior room, which has a capacity of 860 cubic feet, after deducting 542 feet for the space occupied by the interior room, and the materials of which it is composed. This room has a southern aspect, and is defended from the west winds by a building projecting beyond it, ten feet south. It has one window, with blinds on the outside, to exclude, when necessary, the rays of the sun; the east and south walls are of brick, and are ten inches in thickness: the remaining two are partitions of lath and plaster, four and a half inches thick, which separate between a passage on the west, and a room on the north. The chimney is in the east wall. A small stove is placed in this room, the pipe of which passes through the fire-board. A mercurial thermometer, to measure the temperature of the air, is placed in a convenient situation, on a line with those in the interior room; and on a table, an accurate balance is suspended, to weigh the articles which are to be subjected to experiment.

The plan of the experiments will next be described.

Equal quantities are taken of each article by weight, previously made absolutely dry; by which is to be understood, that state of deprivation of moisture manifested when no diminution in weight can be effected by the heat of a stove at 250° of Fahrenheit.

It is required to determine the length of *time* which the combustion of each article will maintain the temperature of the *interior* room 10° higher than that of the *exterior;* and the time that the interior room is thus maintained by any article, gives its true relative heat, when compared with the time which any other article has maintained the

room at the same difference of temperature. As the temperature of the air in both rooms is supposed to remain *stationary*, the increments and decrements of heat will therefore be equal, in equal periods of time, in all the experiments; and thus the objections made against the *plan* of Count Rumford's experiments, are considered as obviated.

The manner of experimenting is as follows:

The first step to be taken by the operator, is to produce the required difference of 10° between the interior and exterior rooms; and to arrange the coincident circumstances necessary for its perpetuation.

As no artificial refrigerating means can, with convenience, be made use of, to depress the temperature of the exterior room, below that of the atmosphere, it becomes necessary that the temperature of this room shall, in the first instance, be higher than any elevation which will occur in the temperature of the atmosphere during an experiment, otherwise the experiment must fail.

During the many trials of the apparatus, in order to become familiar with its use, and to lessen the great difficulty experienced in maintaining the uniform difference of temperature required, between the interior and exterior rooms, the following incident occurred, by which this difficulty was entirely obviated.

In the month of June, an unusual depression in the temperature of the atmosphere, had taken place during the night season, in consequence of which, the temperature of the exterior room was found, on the following morning, to be 20° above that of the atmosphere. Having been previously obliged to experiment at very high and uncomfortable temperatures, in consequence of the heat of the weather, and presuming that this depression would be transient, and as my assistant, who attended to the exterior room, was absent, no increase was made in its temperature, as had formerly been done, under similar circumstances. The temperature of the interior room was elevated, without previous calculation, 15° above that of the exterior room, at the period of commencement; during this operation, the thermometer in the exterior room had not been observed, but on examination, the difference was found to be precisely 10° between the two rooms; considering it, however, as a fortuitous occurrence, no investigation of the cause was at that time entered into. The trial experiment was commenced, under a firm belief, that the differential thermometer would give immediate notice that the temperature of the exterior room required correction; but, to my astonishment, the differential thermometer was found to vary less than usual, and after a lapse of three hours, although the temperature of the atmosphere was found to have been elevated 12°, the temperature of the exterior room remained *stationary*, and continued so until the completion of the experiment.

No time was then lost in attempting to discover the cause, by which an effect so desirable had been produced, and when examined, it became a matter of surprise that it had not previously been discovered by calculation and experiment, rather than by accident. It may be explained in the following manner:

The interior room contains 512, and the exterior 860 cubic feet of

APPARATUS USED BY M. BULL

IN HIS EXPERIMENTS ON FUEL

Fig. 4

Fig. 3

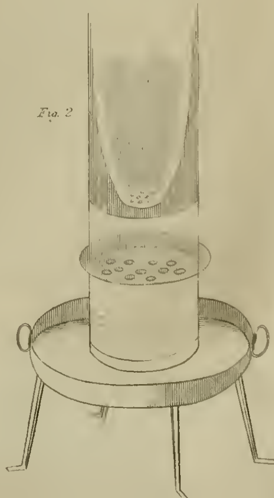


Fig. 2

Drawn by C. Strickland
Engraved by C. G. Childs.

air. As the heat necessary to elevate 512 cubic feet of air 15°, is gradually transferred to 860 cubic feet, consequently, it must increase its temperature so long as its increments are greater than its decrements, and should, by calculation, *cæteris paribus*, augment it nearly 9°, instead of 5°, as was found to be the case; but as the exterior room presents very nearly double the conducting surface, this will account for the difference.

When the temperature of the interior room is thus elevated 15°, the exterior is consequently elevated 5°, by which the required difference of 10° is produced, and the temperature of the exterior room then becomes *stationary*, that being the precise point at which the increments and decrements of heat are equal in the air of *both rooms*.

The manner of producing this important result under known circumstances, being established, the operator has only to seek for the same result in a different place, under an unknown, or known difference of circumstances. As the surface of the window (the barricade having been removed) is the only part of the exterior room which can be speedily operated upon by the ordinary changes of the atmosphere, the temperature of the room, must, therefore, from its situation, and the nature of its walls, change very little; if, however, during an experiment, any indication of an increase in its temperature is observed, the upper sash in the window, which is suspended with weights, is lowered the required distance to correct it; but if decreasing, a fire of wood can be immediately kindled in the stove, a lamp being kept burning in this room for the purpose, although never required, but in two instances, during my experiments.

The required difference of temperature, between the two rooms, being adjusted, it is maintained for about half an hour, by burning dry charcoal. The article to be subjected to experiment is then accurately weighed, and if it is wood, the unconsumed charcoal is wholly removed from the stove by a small pair of tongs, and deposited in another room; and the wood, which is used in pieces two inches long, and from one quarter, to one half of an inch thick, is ignited by the flame of a lamp; but if it is any of the species of coal which cannot be ignited *per se*, the burning charcoal is taken from the stove and weighed, and its quantity either increased or diminished, so as to make half an ounce, which is quickly returned to the stove; and on my notes, the name of the article, its quantity, and the time, by an accurate watch, are then set down, together with the state of the thermometers, the barometer, and hygrometer. The heights of the thermometers are noted every ten minutes during the experiment, that in the exterior room being always known, by comparing the mercurial, and differential thermometers, of the interior room.

The last ten minutes of time which is noted as finishing an experiment, is that to which its termination approaches the nearest; the variation therefore, from the exact time, cannot be more, but will generally be less than five minutes, which is, in many cases, as near, perhaps, as it can be determined, and the greatest difference stated, will not affect the mean of the results one per cent.

The anthracite coal cannot be wholly consumed, even in the in-

proved state of the stove, the upper chamber having been introduced after its first construction, to provide a space for the purpose of heating the air as much as possible, before coming in contact with the burning body, by which the quantity remaining unconsumed is reduced, from two ounces, to less than half an ounce. That portion which remains unconsumed after an experiment, including the small particles which drop through the apertures of the chambers, into the ash pit, are washed upon a sieve, to remove the ashes, and any other foreign matter, and when thoroughly dried in a crucible, are weighed, and deducted from the original weight.

In making up the results of experiments, in which charcoal is used to ignite the body, from the resulting time, is deducted so much as is known by previous experiment, to have arisen from a portion of charcoal, equal in weight to that used. During tedious experiments, the operator is sometimes under the necessity of passing from the interior to the exterior room, but if this be done with proper caution, the differential thermometer is never affected by it.

The animal heat imparted to the air of the room, by the operator, must be noticed. This, under ordinary exertion of the muscles, being equal both in temperature and quantity, as determined by Dr. Crawford, and being the same during the period of each experiment, the results will not be influenced thereby.

The accuracy with which the experiments have been performed, is a delicate subject for me to expatiate upon; but I shall be permitted to say, that all means within my power, have been used to render the results as accurate as the difficult nature of the subject will admit. These results will be found in the general table.

From the diversity in these results, it is apparent, that equal weights of different combustible bodies, vary materially in the quantity of heat disengaged in their combustion. The woods differ less, perhaps, in *equal weights*, than has been generally supposed, and that difference will be found to correspond very nearly with the different quantities of carbon they contain; they are, however, of very different value in *equal quantities by measure*, in consequence of the great disparity in their *weight*. This remark is also applicable to those coals which are sold by measure, and not by weight; from which circumstance, it becomes necessary to *caution* those who would attempt to ascertain the value of different articles of fuel, by merely comparing their different results of heat in the table, without regard to their different weights. The results being comparisons between articles in equal weights, cannot be compared with quantities by measure alone; hence the necessity of determining the weights of a given bulk of those articles sold in this manner, which will be found in the table, in their respective columns, the manner of obtaining which, will be hereafter detailed. The object of my experiments being practical utility, rather than scientific research, to facilitate the accomplishment of that desirable object, I have estimated the comparative values of the different articles. These will be found in the last column of the table, and are equally applicable, not only to every market, but for every change in the prices that can take place.

The standard taken is shell-bark hickory, that being of greater weight than a cord of any other wood in the table, and disengaging in its combustion, an equal quantity of heat, from any given weight.

The comparative numbers express the value of one cord of each of the woods, one ton of the anthracite coals, and one hundred bushels of the bituminous coals, charcoal and coak; and although no one market is supposed to furnish, for fuel, every kind of wood contained in the table, yet the principal part will probably be found, and in markets where the woods are much mixed, averages may easily be made, adapted to those markets. The column of comparative values was found in the following manner.

The value of a given quantity of fuel, is directly proportional to the *time* that a given weight of it maintained the air of the room at a given temperature, and also to its *weight*. Hence, assuming shell-bark hickory for a standard, since one pound of this wood maintained the air of the room, at the given temperature, 400 minutes, this being multiplied by 4469, the weight of a cord of this wood, we obtain 1787600 minutes, as the time which the air of the room would have been maintained at the given temperature, by consuming one cord of this wood.

We then have the following proportion. As the product in time corresponding to one cord of shell-bark hickory, (1787600) is to its assumed value (100) so is the product of the weight of a given quantity of any other article, into the time that one pound of it would maintain the air of the room at the given temperature, to the value of the given quantity of this article.

Thus for a cord of white ash wood:

$$\text{As } 1787600 : 100 :: 3450\times400=138000000 : 77$$

For a ton of Lehigh coal, of 2240 pounds:

$$\text{As } 1787600 : 100 :: 2240\times790=176960000 : 99$$

For 100 bushels of cannel coal, weighing 6525 pounds:

$$\text{As } 1787600 : 100 :: 6525\times630=411075000 : 230$$

A few examples will be sufficient to show the facility with which the comparisons may be made. For this purpose, we will assume the price of shell-bark hickory wood, as at six dollars, for a cord of 128 cubic feet, this being the average price in this market, and compare it with a cord of red-heart hickory. The comparative value of the former is 100, and of the latter 81. We then have the following statement. As 100 : 600 : : 81 : 486. Four dollars and eighty-six cents being the comparative value of a cord of red-heart hickory, and the difference between the price of this wood, and its comparative value, thus ascertained, shows how much dearer or cheaper it is, than the wood with which it has been compared. We will suppose the price of red-heart hickory to be 5.75, and that of chesnut white oak to be 5 dollars. Then 81 : 575 : : 86 : 610, is the value of the latter, which being sold at 5 dollars, is cheaper, by one dollar and ten cents, than the red heart hickory. If we take the mean of the com-

parative numbers for the eleven different species of oaks, which is 69, and compare them at 5 dollars, with shell-bark hickory at 6 dollars, 100 : 600 : : 69 : 414, is the average value of those oaks, and at the prices specified, the hickory is the cheapest, by nearly one dollar.

A mere examination of the comparative numbers, will show, that a cord of white birch is 52 pr. ct. less in value than a cord of shell-bark hickory, and the difference *per cent.* may be calculated, from the comparative numbers between any two articles sold at the same price.

We will now extend the comparison to some of the coals: and take, for this purpose, one cord of shell-bark hickory, at 6 dollars. and determine the comparative value of one ton of Lehigh coal. As 100 : 600 : : 99 : 594, which shows them to be of nearly the same value, supposing each article to be consumed under the same circumstances; but as this is not the case, and as this objection has been frequently stated to me, by those who have confounded two distinct subjects, a momentary digression will be excused, to show the futility and irrelevancy of this objection. It is admitted, that there may be greater disparity between the manner of consuming different kinds of fuel, than actually exists in their comparative value, as usually sold; but this difference does not enhance or depress the value of the different articles, provided it is practicable to consume them in the same manner, which, with very few exceptions, may be done. The intrinsic value of the different kinds of fuel, and the loss or gain experienced by the different constructions of the apparatus used for their combustion, are distinct subjects of inquiry; and although both are necessary to be known, to effect any valuable improvement in the selection of the one, and the construction of the other, yet it does not follow as a consequence, that because the construction of a grate used for the combustion of Lehigh coal, is more economical than an open fire-place, that, therefore, one ton of the coal, possesses greater intrinsic value than one cord of shell-bark hickory wood; as it would be equally relevant, to say, that the coal is intrinsically of less value, because the wood may be consumed in a sheet iron stove, which is a much more economical apparatus than the grate.

We will resume the subject, by comparing one ton of Lehigh coal, at seven dollars, with one hundred bushels of Newcastle coal, at thirty-five dollars, which are the present prices in this market. As 99 : 700 : : 198 : 1400, from which, it appears that fifty bushels of this coal are precisely equal in value to one ton of Lehigh coal, but as the Newcastle coal will cost seventeen dollars and fifty cents, and the Lehigh coal, costs only seven dollars, the latter is the cheaper article of fuel, by 150 per cent.

If the value of a chaldron or bushel of the bituminous coal is required, the manner of obtaining a solution of either question, is obvious.

It will be apparent, that although shell-bark hickory has been taken, for convenience, as the standard, to construct the column of comparative values, the economist should take the cheapest article of fuel in the market, as his standard of comparison.

The experiments on the Lehigh, Schuylkill, Susquehanna, and

Lackawaxen coals, were repeated a number of times, in different quantities, but the results were found to be uniformly the same. Considerable difference was found in the results of pine charcoal, when taken promiscuously from different parcels as brought to market, in consequence of the imperfect manner in which the charring process had been conducted; but as these coals are sold by measure, and not by weight, and as the bulk is not materially diminished in perfecting the process, the loss sustained from this circumstance, being in part compensated by the heat disengaged in expelling the remaining inflammable matter, we may consider this defect, in ordinary cases, as unimportant; the result, however, is given for perfect charcoal.

The coak used to experiment upon, was produced in the large way, and that which was most free from earthy, or other foreign matter, as well as most perfect in other respects, was selected. The heat resulting from its combustion is less than was anticipated, and shows, that the commonly received opinion, that it contains as much carbonaceous matter as charcoal, in equal weights, is erroneous; and what is still more erroneous, is, the opinion that any given quantity of coak, by *measure*, will, in its combustion, disengage as much heat, as an equal quantity of the coal from which it is produced. One bushel of bituminous coal produces, in retorts, about one and a half bushels of coak, in consequence of its swelling during the process, and yet its specific gravity is stated, in some tables, as nearly equal to that of the coal.

The composition balls of Lehigh coal, charcoal, and fire clay, were made for the purpose of ascertaining whether a very economical fuel might not be formed of the culm, or fine portions of the two former, by combining them with the latter article, as they possess very little value; the same practice having been adopted, with considerable advantage, in various parts of Europe.

The fire produced by these balls, was found to be very clean, and beautiful in its appearance; its superior cleanliness is in consequence of the ashes being retained by the clay, the balls being found to retain their original shape, after they were deprived of the combustible materials. The beauty of the fire is enhanced by the shape and equality in the size of the balls, which, during the combustion, present uniform luminous faces. No difficulty was found in igniting, or perfectly consuming the combustible materials of the balls; and the loss in heat, when compared with the combustion of the same quantity of each article, in their usual states of aggregation, was found to be only three per cent.

It is proper to state, that the experiments were made with articles of the best quality that could be procured, and as some slight difference may exist between wood of different ages, the medium sizes were selected. Those woods and coals, which are peculiar to the New England States, were obtained from thence. The Rhode-Island and Worcester coals, were procured for me by an obliging friend in Boston, who stated, that the coals were selected with care, but, that the Worcester coal, being a recent discovery, and the parcel sent

having been taken from the surface of the bed, it could not be considered as a fair sample of the coal which may be supposed to exist in lower strata.

Many and insuperable difficulties presented themselves, in attempting to ascertain, by common methods, the weight in a cord of dry wood, of each kind. The plan adopted, and which appeared most likely to produce satisfactory results, was as follows. From a pile of swamp white oak, of medium size, which had been cut the preceding winter, and weather seasoned during the interval, (this being the state in which the largest portion of wood is sold,) a half cord, or sixty-four cubic feet, was accurately measured, and its weight was found to be 1928 pounds avoirdupois. From this half cord, was taken a sufficient number of sticks, of various sizes, to allow one piece to be sawn from each, twelve inches long, to produce $\frac{1}{64}$ part of the whole weight; which being done, the pieces of wood were placed in a foot "*corder*," or space twelve inches square, made by nailing four pieces of board together at the ends; but the wood not being found to fill it equally in the first instance, other pieces were substituted, of *equal weight*, until the interstices between the sticks presented a similar appearance to that of wood, as ordinarily piled up for sale.

This parcel of wood was then perfectly dried in an oven, and its solid contents ascertained by the quantity of water which it displaced. To perform this operation, a tin box was used, fifteen inches deep, and six inches wide at the open top, which was set into a large tin funnel; and the water, displaced by the wood, was conveyed by the latter into an earthen vessel placed underneath, for its reception. The pieces of wood were taken separately, and into one end of each, a small awl was inserted, a sufficient distance to sustain the weight of the stick, and by which it could be accurately and expeditiously immersed in the water. As the surface of the wood could not be made impervious to water, without a change in its bulk, it became necessary to perform the operation with as much dexterity as possible; the wood, however, being perfectly dry, its surface was covered with dust, which caused it to *repel* the water in the first instance, and I found it could be immersed steadily, and yet with such facility, as to be left nearly dry, if shaken immediately on being withdrawn from the water, and this was determined by the very slight addition which was found to have been made to its weight by the immersion. For this addition to the weight of the wood, the water used being at 55° Fahrenheit, a correction was made, and added to the quantity of water displaced, although a partial compensation may be considered to have taken place, by the expansion produced in the wood, in consequence of the absorption of this portion of the water.

The water displaced, was measured in a deep narrow vessel, provided with a sliding scale, fitted to its interior, for the purpose; and found to be 965 cubic inches, from which the quantity of *plenum*, or solid dry wood, in a cord, taken under the circumstances described, was found to be $71\frac{1}{2}$ cubic feet; leaving a deficiency for the interstices, and diminution in volume by drying, of $56\frac{1}{2}$ cubic feet. Thus,

$$1 : 965 :: 128 : 123520, \text{ which } \div 1728 = 71.\tfrac{832}{1728} \text{ cubic feet.}$$

The method taken, it is supposed, will give the average quantity of *combustible matter*, in a cord of wood, as usually sold; it being impossible for me to give a scale adapted to every change in volume, produced by the different degrees of humidity, of which the woods are susceptible.

The solid content of a cord of wood being known, if the specific gravity of any wood is correctly ascertained, its absolute weight may be determined thereby.

The usual method of ascertaining the specific gravity of wood, as laid down in the books, is manifestly incorrect; as the absorption of water, during its immersion, produces an enlargement in the *magnitude* of the body, not compensated for by adding to the water weight, if the body is lighter, (or deducting, if heavier than water,) the weight of water found to have been absorbed; and this absorption must constitute complete saturation, before the water weight can be accurately ascertained; because, during this process of absorption, the air being constantly expelled from the body, part of it adheres to it in small globules, and renders it more buoyant, in proportion as this bulk of air is lighter than the same bulk of the body; consequently, the body weighs less than it should do, and this cause of error cannot be counteracted by an attempt to weigh the body "*expeditiously*," as is recommended. During this necessary process of saturating the body with water, the wood increases in magnitude, and its specific gravity will be found less than it should be; and the difference will be seen to be very considerable, when it is stated, that the specific gravity of a piece of dry wood, weighing in air 11.15 grains, was, by the common method, found to be .556, and the same piece of wood being then dried with great care to its former weight, its specific gravity found by a process free from this objection, (hereafter to be described,) was .619, the difference in which would be 282 lbs. in one cord of wood.

The specific gravity of those bodies which do not change in their *magnitude*, by the absorption of water, and which have no *fissures*, may be correctly obtained by the common method, as the water absorbed is retained in the body, and can thereby be ascertained, as it will be of the exact weight by which the water weight had been increased or diminished, in consequence of the expulsion of an equal bulk of air from the body.

Our object in ascertaining the specific gravities of bodies, is to find the proportion of their weights under the same volume. Now, by the volume of a body, is to be understood the entire space enclosed within its exterior surface, including its pores and fissures. It is necessary, therefore, in determining the sp. gr. by the usual method of the hydrostatic balance, to use some means for preventing the water from insinuating itself into the pores and fissures of such bodies as are not of a perfectly compact texture. If the article employed for this purpose, be of a sp. gr. different from water, and if (as will almost always be the case) it protrude beyond the surface of the body, so as to enlarge the bulk, it will be necessary not only to know its weight in air, but its specific gravity; and even then it is difficult to make a satisfactory correction of the water weight, in consequence of the change

which the article made use of, may sustain in its specific gravity by pressure in applying it to the body, and also, from the different specific gravity of different parts of articles not expressly prepared for the purpose.

As it was necessary for me to determine, with great accuracy, the specific gravities of dry wood, charcoal, and the mineral coals, all of which absorb water, and present more or less fissures, and as I wished to relieve myself from liability to inaccuracies from the sources which have been detailed, I determined to make a compound which should be convenient to use, and whose specific gravity should be precisely that of water at 60° Fahrenheit.

This was effected with white wax and yellow rosin; the specific gravity of the former was .967, and of the latter 1.079. The compound was of the best possible consistence, and whether compressed by mechanical means, at a low temperature, or expanded by the temperature of water at 120°, it would in either case be unity, when brought to the temperature of 60°, and the whole mass was perfectly uniform.

The difficulty of producing this compound, was much greater than had been anticipated, and will be apparent, when it is stated, that the mass weighed at the commencement, about two ounces, taken by arithmetical calculation, in the proportions supposed to be necessary, which were 46 grains of rosin to 100 grains of wax, and although the smallest additions supposed necessary, were made at each time to this mass, from two other masses of the same articles compounded, whose specific gravities were known to be about .995 and 1.005, the mass weighed, when finished, more than thirty ounces, and required seven days to accomplish the undertaking; and the proportions of the ingredients found to have been used, were about 22 grains of rosin to 100 grains of wax. Having had occasion to use some of this compound within a short time, I regret to say, that the lapse of two years since it was made, has produced a change in its specific gravity; it being now 1.004 in water at the temperature of 60° Fahrenheit.

The pieces of wood being made positively dry, in the manner described for drying those experimented upon, they were covered with the compound described, without regard to its weight, and their specific gravities being ascertained, the absolute weight of dry wood in a cord of each, was found in the following manner, and will be seen in the table.

The weight of a cubic foot of any substance, whose specific gravity is 1, is known to be very nearly 1000 ounces, or $62\frac{1}{2}$ pounds avoirdupois. Hence, to find the weight of a cord of wood, or $71\frac{1}{2}$ cubic feet of *plenum*, of specific gravity 1, (for example, shell-bark hickory) we have only to multiply 71.5 by 62.5, which gives us 4468.75. Now, to find the weight of a cord of wood, of any other specific gravity, we say, As *unity* is to (4468.75) the weight of a cord at specific gravity 1, so is the given specific gravity, to the weight of a cord at that specific gravity. Thus, for white ash; 1 : 4468.75 : : .772 : 3449.87 pounds. In fact, we have, in any case, merely to multiply 4468.75

by the specific gravity of any other wood, to obtain the weight of a cord of this wood, in pounds and decimals avoirdupois.

The quantity of charcoal which can, by the best conducted process, be obtained from the different woods, was deemed an inquiry of considerable importance, there being great discrepancies in the results of different experimenters on this subject, and from the vast importance and consumption of this article, in the arts generally, and particularly in the process of smelting iron ore. For this purpose, all attempts hitherto made in this country, to substitute anthracite coals, have proved nugatory; and, as equally unsuccessful results have attended the numerous and well conducted experiments, which have been made in England, Ireland, and Wales, to substitute anthracite coals for coak, in the same important process, it becomes a matter of national interest, that our forests, intended for this purpose, should not be unnecessarily wasted, by conducting the charring process in an improper manner, and this can only be ascertained, by first knowing the positive quantity of carbon contained in the different woods, from which we shall be able to determine whether any improvements can be made in the process.

Various methods have been adopted by different experimenters on this subject; that most generally used appears to have been charring the woods in dry sand; but I found this objectionable, as the finer portions of the sand were liable to enter the interior of the coal, if it had any fissures, and the weight of the product was too large; while on the other hand, the interstices between the particles of sand were found to admit sufficient air to consume part of the coal, and the product in consequence of this combustion was liable to be found too small. To obviate both these objections, pulverized charcoal, known to have been perfectly charred and dry, was substituted for sand, having ascertained that it could be almost entirely shaken out of the fissures in the coal, and that, should any remain, the error would be immaterial. The pieces of wood were closely packed in it, preserving an inch in thickness of powdered coal between the sides and bottom of the crucible and the wood, and about three inches of powdered coal on the top of the wood, the whole being covered by an inverted crucible, luted down. In this latter crucible, only a small orifice was made; any air, therefore, which should enter through the pores of the crucible or the aperture at top, would be decomposed, before it could reach the wood in the interior; and the air which may be supposed to have existed between the interstices of the powdered coal, or in the coal itself in the first instance, would also be decomposed and rendered inert, before the wood could be charred. The whole of the woods, which had been previously filed into oblong solids, presenting sharp edges, to detect any loss by fracture, each being designated by notation letters, made by incision, were thus surrounded and exposed in the first instance to a moderate heat in an air furnace, which was increased to a white heat, and so remained for about two hours, during which time additional quantities of powdered coal were introduced through the aperture at the top of the inverted crucible.

The product of charcoal from the several woods obtained in this manner, will be found in the table.

Among the many experiments made to discover the best manner of ascertaining the weight of charcoal product, from the different woods, and to satisfy myself whether any loss could take place in a solid piece of coal surrounded by powdered charcoal, a piece of box wood coal, without fissures, was taken, weighing 23.7 grains, and after having been exposed to a white heat for three hours, was found to weigh 23.1 grains; the loss of $\frac{6}{10}$ of a grain, was, however, undoubtedly, produced by the air contained in the piece of coal, or conjointly with that in the interstices between the powdered coal, contiguous to the piece when first ignited.

A similar experiment was made in clean, dry, white sand, upon a piece of maple coal without fissures, which had been previously exposed in powdered charcoal to a white heat, and known to be perfectly charred and dry. This piece of coal weighed 26 grains, and lost by the process 6 grains; the surface was found entirely changed from its original hard texture, having become soft; and the colour changed from slate, to jet black; which is often found to be the case in charcoal obtained in the large way, and is always objectionable, as it produces loss both to the collier and the consumer.

The charcoal produced by surrounding the wood with powdered coal, was found of a slate colour on its surface, dense, sonorous, brittle and equal in all respects to that made in cylinders or retorts for gunpowder, which is known to be much superior, even for common purposes, to that produced by the ordinary method, from its greater durability; although for these purposes, no particular necessity exists that the pyroligneous acid and tar should be perfectly expelled. From the preceding experiment in sand, it occurred to me that an important improvement might be made in the common process, by filling the interstices between the sticks of wood with the culm or fine coal, left on the ground after the large coal has been drawn from the pit; and by covering the wood more perfectly than is usually done. In this way we may more perfectly prevent the access of the air, which is not only destructive, in many cases, to a large portion of the coal, but also renders what remains, less valuable.

A series of experiments was made on a large number of woods, to determine the difference, if any existed, in the product of charcoal from green, and from dry wood; these being taken from the same sticks in equal weights when green, they would both contain the same quantity of ligneous matter. The product was not found to be essentially different, but, invariably, rather larger from the dry, than from the green wood; the specific gravity of the former was also greater; I have no hesitation, however, in saying that there will be less loss in charring wood in the large way by using dry wood, as it can be ignited more equally, and with greater facility.

Dead wood was found to produce the same quantity of charcoal as the same wood in a living state, and the limbs of trees to produce coal of much greater density than the trunk. Among the most dense

woods, stove dry ebony, sp. gr. 1.090, gave a product of charcoal from 100 parts of wood, of 33.82, which is larger than was obtained from any other wood, and its specific gravity was also greater, being .888; its fracture so much resembles that of some of the mineral coals, that it is difficult to say in what respects they differ. Stove dry live oak, sp. gr. .942, gave 32.43, sp. gr. .591. Tortoise-shell wood, sp. gr. 1.212, gave 30.31, sp. gr. .866. Cocoa, sp. gr. 1.231, gave 28.53, sp. gr. .742. Turkey box, sp. gr. .933, gave 27.24, sp. gr. .622.

A piece of box wood polished, lost very little of its lustre by charring in powdered coal, and the beautiful variations in the grain of the wood were as apparent in the coal as in the wood; this experiment, therefore, may be considered conclusive, as to the complete exclusion of air by this process.

It does not appear from the products of charcoal from the different woods, that their density or durability is to be attributed to the quantity of carbon they contain. As the woods differ materially in the quantity of charcoal product by measure, it appeared necessary to give the product from a cord of each, in bushels; and as the value of these can only be determined by their weight, this also was ascertained, and both will be found in the table.

The bushel generally used in this country contains 2150.4 cubic inches, but as coals are sold by what is termed "*rounded measure*," or partially heaped, it became necessary to ascertain the cubical content of a body of coal thus measured. For this purpose one bushel of charcoal was made perfectly dry, and the mean specific gravity of a large number of pieces was found to be .285, and the weight of the bushel of coal was fifteen pounds avoirdupois, or 105000 grains, and the absolute weight of a cubic foot of coal whose specific gravity is .285, is 124687 grains, and a cubic foot being 1728 cubic inches, then we have the following statement: As 124687 : 1728 : : 105000 : 1455 solid inches of coal in the bushel, which being known, the absolute weight of a bushel of each of the coals, was calculated from their specific gravities, in the following manner:

The weight of a cubic foot or 1728 cubic inches of any substance, whose specific gravity is 1, being 1000 ounces, consequently the weight in ounces of a bushel containing 1455 cubic inches of any substance, of the same specific gravity, will be found by the following proportion:

As 1728: 1000: :1455: 842=52.62 pounds.

Now to find the weight of a bushel of a substance of any other specific gravity, we say; As *unity* is to (52.62) the weight of a bushel at specific gravity 1, so is the given specific gravity, to the weight of a bushel at that specific gravity. Thus for white ash charcoal, we have, As 1 : 52.62 : : .547 : 28.78 pounds.

From a number of comparisons, made by actual measurement, of different mineral coals, it is believed the weights expressed in the table will be found sufficiently correct in every instance.

The hydrostatic balance made use of to ascertain the specific gravities of the different bodies expressed in the table, is sensibly affected

by $\frac{1}{100}$ part of a grain, when not loaded, and the weights were made to twentieth parts of a grain in every instance.

From experiments made to ascertain the weight of moisture absorbed by the different woods, which had previously been made perfectly dry, and afterwards exposed in a room in which no fire was made during a period of twelve months, the average absorption by weight, for this period, was found to be 10 per cent. in forty-six different woods, and 8 per cent. in the driest states of the atmosphere; an unexpected coincidence was found to exist in the weight absorbed by forty-six pieces of charcoal made from the same kinds of wood, and similarly exposed, the latter being also 8 per cent.

The quantity of moisture absorbed by the woods individually, was not found to diminish with their increase in density; while it was found that the green woods, in drying, uniformly lost less in weight in proportion to their greater density. Hickory wood taken green, and made absolutely dry, experienced a diminution in its weight of $37\frac{1}{2}$ per cent., white oak, 41 per cent. and soft maple, 48 per cent.; a cord of the latter will therefore weigh nearly twice as much when green as when dry.

If we assume the mean quantity of moisture in the woods, when green, as 42 per cent., the great disadvantage of attempting to burn wood in this state must be obvious, as in every 100 pounds of this compound of wood and water, 42 pounds of aqueous matter must be expelled from the wood, and as the capacity of water for absorbing heat is nearly as 4 to 1, when compared with air, and probably greater during its conversion into vapour, which must be effected before it can escape, the loss of heat must consequently be very great.

The necessity of speaking thus theoretically on this point, is regretted; but, it will be apparent, that this question of loss, cannot be solved by my apparatus, as the vapour would be condensed in the pipe of the stove, and the heat would thereby be imparted to the room, which, under ordinary circumstances, escapes into the chimney.

The average weight of moisture in different woods which have been weather seasoned from eight to twelve months, will not be found to vary materially from 25 per cent. of their weight; every economist, therefore, will see the propriety of keeping his wood under cover in all cases where this is practicable.

Common Nam	Gra- dry	Pounds of dry Coal in one bushel.	Pounds of Charcoal from one cord of dry Wood.	Bushels of Charcoal from one cord of dry Wood.	Time 10° of Heat were maintained in the room, by the combustion of one pound of each article.	Value of specified quantities of each article, compared with Shell-bark Hickory as the standard.
					H. M.	Cord.
WHITE ASH,		28.78	888	31	6 40	77
APPLE TREE		23.41	779	33	6 40	70
WHITE BEEC		27.26	635	23	6	65
BLACK BIRCH		22.52	604	27	6	63
WHITE BIRC		19.15	450	24	6	48
BUTTER-NUT		12.47	527	42	6	51
RED CEDAR,		12.52	624	50	6 40	56
AMERICAN C		19.94	590	30	6 40	52
WILD CHERR		21.63	579	27	6 10	55
DOG WOOD,		28.94	765	26	6 10	75
WHITE ELM,		18.79	644	34	6 40	58
SOUR GUM,..		21.05	696	33	6 20	67
SWEET GUM,		21.73	558	26	6	57
SHELL-BARK		32.89	1172	36	6 40	100
PIG-NUT HICK		33.52	1070	32	6 40	95
RED-HEART H		26.78	848	32	6 30	81
WITCH-HAZEL		19.36	750	39	6 10	72
AMERICAN HO		19.68	613	31	6 20	57
AMERICAN HO		23.94	611	25	6	65
MOUNTAIN LA		24.05	712	30	6 40	66
HARD MAPLE,		22.68	617	27	6 10	60
SOFT MAPLE,		19.47	551	28	6	54
LARGE MAGNO		21.36	584	27	6 10	56
CHESNUT WH		25.31	900	36	6 30	86
WHITE OAK,..		21.10	826	39	6 20	81
SHELL-BARK W		22.99	745	32	6 20	74
BARREN SCRU		20.63	774	38	6 30	73
PIN OAK,......		22.94	742	32	6 20	71
SCRUB BLACK		20.36	774	38	6 30	71
RED OAK,.....		21.05	630	30	6 20	69
BARREN OAK,		23.52	694	29	6 20	66
ROCK CHESNUT		22.94	632	28	6	61
YELLOW OAK,.		15.52	631	41	6 10	60
SPANISH OAK,.		19.05	562	30	6 20	52

GENERAL TABLE.

Common Names of Woods and Coals.	Botanical Names.	Specific Gravities of dry Wood.	Avoirdupois pounds of dry Wood in one cord.	Product of Charcoal from 100 parts of dry Wood, by weight.	Specific Gravities of dry Coal.	Pounds of dry Coal in one bushel.	Pounds of Charcoal from one cord of dry Wood.	Bushels of Charcoal from one cord of dry Wood.	Time 10° of Heat were maintained in the room, by the combustion of one pound of each article.	Value of specified quantities of each article, compared with Shell-bark Hickory as the standard.
									H. M.	Cord.
WHITE ASH,	*Fraxinus americana,*	.772	3450	25.74	.547	28.78	888	31	6 40	77
APPLE TREE,	*Pyrus malus,*	.697	3115	25	.445	23.41	779	33	6 40	70
WHITE BEECH,	*Fagus sylvestris,*	.724	3236	19.62	.518	27.26	635	23	6	65
BLACK BIRCH,	*Betula lenta,*	.697	3115	19.40	.428	22.52	604	27	6	63
WHITE BIRCH,	*Betula populifolia,*	.530	2369	19	.364	19.15	450	24	6	48
BUTTER-NUT,	*Juglans carthartica,*	.567	2534	20.79	.237	12.47	527	42	6	51
RED CEDAR,	*Juniperus virginiana,*	.565	2525	24.72	.238	12.52	624	50	6 40	56
AMERICAN CHESNUT,	*Castanea vesca,*	.522	2333	25.29	.379	19.94	590	30	6 40	52
WILD CHERRY,	*Cerasus virginiana,*	.597	2668	21.70	.411	21.63	579	27	6 10	55
DOG WOOD,	*Cornus florida,*	.815	3643	21	.550	28.94	765	26	6 10	75
WHITE ELM,	*Ulmus americana,*	.580	2592	24.85	.357	18.79	644	34	6 40	58
SOUR GUM,	*Nyssa sylvatica,*	.703	3142	22.16	.400	21.05	696	33	6 20	67
SWEET GUM,	*Liquidambur styraciflua,*	.634	2834	19.69	.413	21.73	558	26	6	57
SHELL-BARK HICKORY,	*Juglans squamosa,*	1.000	4469	26.22	.625	32.89	1172	36	6 40	100
PIG-NUT HICKORY,	*Juglans porcina,*	.949	4241	25.22	.637	33.52	1070	32	6 40	95
RED-HEART HICKORY,	*Juglans laciniata,?*	.829	3705	22.90	.509	26.78	848	32	6 30	81
WITCH-HAZEL,	*Hamamelis virginica,*	.784	3505	21.40	.368	19.36	750	39	6 10	72
AMERICAN HOLLY,	*Ilex opaca,*	.602	2691	22.77	.374	19.68	613	31	6 20	57
AMERICAN HORNBEAM,	*Carpinus americana,*	.720	3218	19	.455	23.94	611	25	6	65
MOUNTAIN LAUREL,	*Kalmia latifolia,*	.663	2963	24.02	.457	24.05	712	30	6 40	66
HARD MAPLE,	*Acer saccharinum,*	.644	2878	21.43	.431	22.68	617	27	6 10	60
SOFT MAPLE,	*Acer rubrum,*	.597	2668	20.64	.370	19.47	551	28	6	54
LARGE MAGNOLIA,	*Magnolia grandiflora,*	.605	2704	21.59	.406	21.36	584	27	6 10	56
CHESNUT WHITE OAK,	*Quercus prinus palustris,*	.885	3955	22.76	.481	25.31	900	36	6 30	86
WHITE OAK,	*Quercus alba,*	.855	3821	21.62	.401	21.10	826	39	6 20	81
SHELL-BARK WHITE OAK,	*Quercus obtusiloba,?*	.775	3464	21.50	.437	22.99	745	32	6 20	74
BARREN SCRUB OAK,	*Quercus catesbæi,*	.747	3339	23.17	.392	20.63	774	38	6 30	73
PIN OAK,	*Quercus palustris,*	.747	3339	22.22	.436	22.94	742	32	6 20	71
SCRUB BLACK OAK,	*Quercus banisteri,*	.728	3254	23.80	.387	20.36	774	38	6 30	71
RED OAK,	*Quercus rubra,*	.728	3254	22.43	.400	21.05	630	30	6 20	69
BARREN OAK,	*Quercus ferruginea,*	.694	3102	22.37	.447	23.52	694	29	6 20	66
ROCK CHESNUT OAK,	*Quercus prinus monticola,*	.678	3030	20.86	.436	22.94	632	28	6	61
YELLOW OAK,	*Quercus prinus acuminata,*	.653	2919	21.60	.295	15.52	631	41	6 10	60
SPANISH OAK,	*Quercus falcata,*	.548	2449	22.95	.362	19.05	562	30	6 20	52

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Common Names of Woods and Coals.	Botanical Names.	Specific Gravities of dry Wood.	Avoirdupois pounds of dry Wood in one cord.	Product of Charcoal from 100 parts of dry Wood, by weight.	Specific Gravities of dry Coal.	Pounds of dry Coal in one bushel.	Pounds of Charcoal from one cord of dry Wood.	Bushels of Charcoal from one cord of dry Wood.	Time 10° of Heat were maintained in the room, by the combustion of one pound of each article.	Value of specified quantities of each article, compared with Shell-bark Hickory as the standard.
									H. M.	Cord.
PERSIMON,	*Diospyros virginiana,*	.711	3178	23.44	.469	24.68	745	30	6 30	69
YELLOW PINE, (SOFT,)	*Pinus mitis,*	.551	2463	23.75	.333	17.52	585	33	6 30	54
JERSEY PINE,	*Pinus inops,*	.478	2137	24.88	.385	20.26	532	26	6 40	48
PITCH PINE,	*Pinus rigida,*	.426	1904	26.76	.298	15.68	510	33	6 40	43
WHITE PINE,	*Pinus strobus,*	.418	1868	24.35	.293	15.42	455	30	6 40	42
YELLOW POPLAR,	*Lyriadendron tulipifera,*	.563	2516	21.81	.383	20.15	549	27	6 10	52
LOMBARDY POPLAR,	*Populus dilatata,*	.397	1774	25	.245	12.89	444	34	6 40	40
SASSAFRAS,	*Laurus sassafras,*	.618	2762	22.58	.427	22.47	624	28	6 20	59
WILD SERVICE,	*Aronia arborea,*	.887	3964	22.62	.594	31.26	897	29	6 20	84
SYCAMORE,	*Acer pseudo-platanus,*	.535	2391	23.60	.374	19.68	564	29	6 30	52
BLACK WALNUT,	*Juglans nigra,*	.681	3044	22.56	.418	22	687	31	6 20	65
SWAMP WHORTLE-BERRY,	*Vaccinium corymbosum,*	.752	3361	23.30	.505	26.57	783	29	6 30	73
										Ton.
LEHIGH COAL,	. . . .	. .	. .	. .	1.494	78.61	. .	. .	13 10	99
LACKAWAXEN COAL,	. . . .	. .	. .	. .	1.400	73.67	. .	. .	13 10	99
RHODE-ISLAND COAL,	. . . .	. .	. .	. .	1.438	75.67	. .	. .	9 30	71
SCHUYLKILL COAL,	. . . .	. .	. .	. .	1.453	76.46	. .	. .	13 40	103
SUSQUEHANNA COAL,	. . . .	. .	. .	. .	1.373	72.25	. .	. .	13 10	99
SWATARA COAL,	. . . .	. .	. .	. .	1.459	76.77	. .	. .	11 20	85
WORCESTER COAL,	. . . .	. .	. .	. .	2.104	110.71	. .	. .	7 50	59
										100 Bushels.
CANNEL COAL,	. . . .	. .	. .	. .	1.240	65.25	. .	. .	10 30	230
LIVERPOOL COAL,	. . . .	. .	. .	. .	1.331	70.04	. .	. .	9 10	215
NEWCASTLE COAL,	. . . .	. .	. .	. .	1.204	63.35	. .	. .	9 20	198
SCOTCH COAL,	. . . .	. .	. .	. .	1.140	59.99	. .	. .	9 30	191
KARTHAUS COAL,	. . . .	. .	. .	. .	1.263	66.46	. .	. .	9 20	208
RICHMOND COAL,	. . . .	. .	. .	. .	1.246	65.56	. .	. .	9 20	205
STONY CREEK COAL,	. . . .	. .	. .	. .	1.396	73.46	. .	. .	9 50	243
HICKORY CHARCOAL,	. . . .	. .	. .	. .	.625	32.89	. .	. .	15	166
MAPLE CHARCOAL,	. . . .	. .	. .	. .	.431	22.68	. .	. .	15	114
OAK CHARCOAL,	. . . .	. .	. .	. .	.401	21.10	. .	. .	15	106
PINE CHARCOAL,	. . . .	. .	. .	. .	.285	15	. .	. .	15	75
COAK,	. . . .	. .	. .	. .	.557	29.31	. .	. .	12 50	126
COMPOSITION OF TWO PARTS LEHIGH COAL, ONE CHARCOAL, AND ONE CLAY, BY WEIGHT,	. . . .	. .	. .	. .	. .	. .	. .	. .	13 20	

Experiments to determine the comparative loss of Heat, sustained by different constructions of apparatus, ordinarily used for the combustion of Fuel.

The comparative loss of heat, which arises from the different manner in which fuel is consumed, is a subject intimately connected with the question of economy in its use; but it is a distinct subject of inquiry from the former investigation; which was to determine the comparative heat disengaged in the combustion of the various kinds of fuel. It is presumed that the remarks which have already been made, in anticipation, on this point, in detailing the first course of experiments, (at page 271,) will be considered conclusive.

For the purpose of performing these experiments, a slight alteration, only, of the interior room, was required.

The chimney of the exterior room, being situate within twelve inches of the board partition, on the east side of the interior room, an opening was made through the partition, of a sufficient size fairly to expose to the interior room, the fire-place of the chimney; the sides, top, and bottom of this aperture, were then closed by boards, perfectly tight, and this fire-place may now be considered as forming part of the interior room.

All the apparatus, with the exception of the stove, remained the same, and was made use of, as has been before described.

Those constructions of apparatus in most common use, and of proper size for the room, were selected. The experiments could not, without great inconvenience, be extended so as to embrace all the inventions which have been presented to the public, as improvements upon these constructions, but it is believed that those selected, will be sufficient for the object of the inquiry.

The course of experiments was conducted on the same plan as the former; namely, by determining the period of *time* which the air of the interior room could be maintained 10° of temperature above that of the exterior room, in the combustion of equal quantities of fuel, by weight, in each apparatus. In some cases, indeed, it was necessary to use larger quantities of fuel than in others, in order to make satisfactory experiments, yet the results are given for equal weights, and exhibit the time which the air of the room was thus maintained by each apparatus, and are compared with the time which the same weight, and kind of fuel, had maintained the same difference of temperature, in using apparatus No. 9, in the former state of the room; a correction having been made for the slight increase in its size, in consequence of the alteration which has been described. The fuel used in all the experiments was shell-bark hickory wood, of the same quality, and absolutely dry.

It had been apprehended that considerable difficulty would be experienced in producing the required equality in the temperature of the interior room, from the absence of proper means, in some of the apparatus experimented upon, to regulate the combustion; but from

very few trials with each, it was found less difficult than had been anticipated, and that the difficulty could be entirely avoided, by making the quantity of fuel administered to the fire, the regulator of the rapidity and extent of combustion necessary to be produced; which was effected by using the wood in small pieces.

The results have been thrown into a tabular form, and exhibit, as before stated, the comparison of each apparatus with No. 9, in which it is assumed that no loss of heat is sustained; this assumption being necessary, for the purpose of determining the comparative *loss* of heat sustained by each apparatus, which is the object of the experiments.

The manner of obtaining the results, in *time*, having been stated, it is evident, that, as the same quantity of fuel was consumed in every experiment, the same quantity of heat must consequently have been generated. In all the experiments, (except the standard experiment No. 9,) we find that part of the heat escaped by the pipe or flue of the grate, and fire-place, into the chimney, and was lost; and proportional to this loss, must have been the quantity of the fuel required to be consumed in a given time, to maintain the temperature of the room; and, consequently, the duration of each experiment was proportionably affected thereby. The numbers, therefore, which express the duration of each experiment, are proportional to the heat *saved*, and assuming the positive quantity of heat generated, as 100, this being the result of apparatus No. 9, if the time occupied in any other experiment, is deducted from 100, the remainder gives the positive *loss* sustained in every hundred parts of heat generated by using this apparatus, and thence we determine that in using No. 1, as only 10 parts, in every hundred parts of heat generated, are saved, we consequently lose 90 per cent.

As the important difference which exists in the quantity of fuel required to be consumed in different apparatus to produce the same effect, might not in all instances be obvious, by a cursory inspection of the numbers in the first column of the table, the second column of numbers has been inserted, to facilitate these comparisons. The great disparity in the quantity of fuel required to produce the same effect, in No. 1 and No. 2, may, at first view, appear paradoxical, if compared with the quantity of heat saved by each, from 100 parts generated, as only 8 parts more heat are saved by No. 2, than is saved by No. 1, and yet the positive saving in fuel by using No. 2, is nearly 45 per cent.

To find the numbers in the second column, we assume the fuel used in all the experiments, as 100; and for the facility of comparison, we will say that this quantity of fuel maintained the temperature of the room for 100 minutes, when consumed in apparatus No. 9. In experiment No. 1, we find this quantity of fuel maintains the temperature of the room, only 10 minutes, and, consequently, that it would require 10 times as much fuel, as apparatus No. 9, (or 1000,) to maintain the room at the same temperature, for 100 minutes. In the same manner the other numbers are found.

The proportion for the experiments will be clearly explained in the following manner: As the time of the experiment, is to the

quantity of fuel consumed, so is the assumed time of comparison, to the fuel that would be required for that time. Thus for experiment No. 2: As 18 : 100 : : 100 : 555.

By an examination of the numbers in the second column of the table, it will be seen that one dollar, expended in fuel, consumed in apparatus No. 9, is as effective as ten dollars, expended in the same kind of fuel consumed in No. 1; the same quantity of heat being imparted to the room, in both cases. The comparison may be extended in the same manner between any two experiments inserted in the table, and the figures in the second column will be found to express the relative value of fuel for each apparatus, in dollars and cents, by adding a decimal point at the left hand of the two last figures.

Experiments No. 6, 7, and 8, were made with the same stove, for the purpose of determining the difference in the loss of heat, by different constructions and positions of pipe of the *same length*, and which, in all other respects, were similar. From these experiments it will be seen, that the same length of pipe in elbow joints, is much more efficacious in imparting heat to the room, than straight pipe; and as the length of pipe producing a *descending* current, was nearly equal in experiments No. 6 and No. 8, the great advantage which has been supposed to be derived from the descending current, does not appear to exist, although it is undoubtedly more efficacious than the same length and position of pipe, producing an *ascending* current; as the velocity of the current in the former is diminished by the increased resistance which must necessarily be overcome in its descent, while the latter gives greater facility for the heated air to escape, than is given by any other position, in which the pipe can be placed. Experiment No. 7, shows that pipe placed horizontally, is more efficacious in imparting heat, than when placed in a vertical position, either for an ascending, or descending current.

The causes which operate to render the same length of pipe, in elbow joints, more efficacious than any other construction, may be satisfactorily explained. The shape of the pipe, forces the current of heated air to make abrupt turns; in doing which, it impinges against the elbows with sufficient force to invert its internal arrangement, by which change from its former relative situation with the sides of the pipe, a new stratum of hot air, from the interior of the current, is brought more frequently in contact with the sides of the pipe, which facilitates the process of imparting heat, particularly by its being brought in contact with the lower half of the horizontal part of the pipe, which, from various causes, is necessarily the coldest, and is of very little service in imparting heat to the room, without the aid of elbow joints.

From experiment No. 8, an important inference may be drawn; that the advantages gained under ordinary circumstances, by increasing the length of the pipe, has a limit very far short of that, which is found to be necessary, to impart *all* the heat generated, to the air of the room; as in this experiment, only five parts of the heat were lost, in using 13½ feet of pipe, consisting of nine elbow joints; whereas, in apparatus No. 9, eight additional elbow joints, with sixteen

and a half feet of straight pipe, amounting together to $28\frac{1}{2}$ feet of pipe, were required, to save these five parts of the heat, which would otherwise have escaped into the chimney. The reason for this limitation will appear evident, by reflecting, that a heated body loses less in equal periods of time, as its temperature approaches that of the surrounding refrigerating medium, and that the loss of heat will be in the proportion, which the volume of air in the pipe, bears to the volume of air in the room; and, also, proportional to their difference of temperature.

It must not, however, be inferred from this experiment, that $13\frac{1}{2}$ feet of pipe of *any diameter*, and *thickness* of iron, made into elbow joints, will produce the same effect; as the length will require to be increased, with the increase in its diameter; and this will appear obvious, from the fact, that the surface of the pipe does not increase in the ratio of its area or contents of heated air; and as this surface is the medium by which the heat is imparted to the room, and that being effected principally by the contact of the heated air with the sides of the pipe, greater length will be required to produce this necessary contact.

The great advantage of sheet iron stoves, is obvious, from the slight obstruction which they present to the rapid communication of the heat generated, to the air of the room.

From experiment No. 2, the advantage gained by lessening the current of air into the chimney, is clearly demonstrated; this being the principal cause, why this apparatus is more efficacious in warming the room, than No. 1; and this advantage does not arise so much from the excess of heat which enters the room, by using No. 2, as from the diminished quantity of cold air necessary to be admitted, to supply the place of the air that *has been heated*, and of which, by using No. 1, the room is constantly deprived, in much larger volume than by No. 2. The advantage derived from using stove pipe of small diameter, arises from the same cause; and whether the velocity of the current of heated air, is diminished by the construction, position, or length of the pipe, or its volume is diminished by reducing the diameter, the same effect is produced in every case.

I am not in possession of the results of any experiments, if such have ever been made, to determine the ratio of friction experienced by air, when compared with water, in its passage through pipes, under the same pressure. That air does, however, experience a diminution in its velocity, from this cause, will not, it is supposed, be doubted; and this must very materially affect the current of air, through pipes and chimneys.

In practical hydraulics, it is well known, that, without altering the column of pressure, the quantity of water discharged, is greatly diminished, by merely lengthening the conduit-pipe. "Comparing the experiments on the flow of water through conduit-pipes, as recited in Bossuet's *Hydrodynamique*, I find, after making the proper reductions, that the velocity of projection from the bottom of a cistern, is diminished about five times in the passage through a horizontal tube of one inch in diameter, and fifteen feet long. Consequently,

while one part of the actuating force is discharged from the orifice, twenty-four parts are consumed in gliding against the sides of the pipe. Every particle contained, must hence have repeated its contact no less than twenty-four times, before it made its escape; that is, the whole column of fluid must have inverted its internal arrangement, at each interval of $7\frac{1}{2}$ inches."*

The principal article of fuel used in the United States, is forest wood, which, from necessity, or choice, will continue to be so, in many sections of the country, notwithstanding the abundant supply of anthracite and bituminous coals, already discovered in some of the States.

The difficulty of consuming small quantities of anthracite coal, in open grates, must operate to prevent its general introduction into use, unless this difficulty can be removed; any suggestions, therefore, which may possibly tend to lessen this objection to an article of such vast importance to the community, will not be considered irrelevant to my subject.

It is very well known, that no particular difficulty is experienced, under ordinary circumstances, in consuming small quantities of this coal in sheet iron cylinder stoves, lined with fire brick; and it is as well known, that an equally small quantity of this coal, cannot be consumed in an open grate. The inference, therefore, which should be drawn from the knowledge of these facts, is, that the open grate is an apparatus not properly constructed to obtain the desired object, independent of the deleterious gas which it imparts to the room. The question which then presents itself, is, what are the qualities possessed by the former apparatus, in which the latter is deficient?

In the former, the coal is known to be completely surrounded by a thick substance, which, when heated, retains its heat with great tenacity. The air admitted is in small quantity; and, from the construction of the stove, it is necessarily considerably elevated in its temperature, before it comes in contact with the burning body. We infer from these facts, that anthracite coal requires a very high temperature to produce ignition, and, as we know that combustion cannot take place without this prerequisite, the necessary means to effect it, are, consequently indispensable. We also infer, that the commonly received opinion, that this coal requires a very large quantity of air, or "strong draught," to carry on its combustion, is not correct; the converse of this opinion, being nearer the truth; and this may in part be demonstrated by an examination of a single piece of this coal, which has been ignited. If we break the piece of coal, the interior will present its original black colour and lustre, with the exception of an inconsiderable portion near the surface; the body of the coal being sufficiently dense to exclude the access of air, no combustion of its interior can take place; and consequently, the quantity of air, necessary to be admitted to the coals, is nearly proportional to the space presented by *their surfaces*, but not to the positive quantity of coal, as would be the case, nearly, were this ar-

* Leslie on Heat, 308.

ticle as pervious to air, as is charcoal. Any excess of air, therefore, is injurious, in proportion as the quantity exceeds that which can unite with what is termed the combustible, or base; inasmuch as it tends to reduce its temperature, and thereby renders it less capable of rapid union with the air, to produce the combustion; and as each successive portion of air in excess, robs the combustible of its heat, we see the fire languish for a short period, and then expire.

Although atmospheric air is generally necessary to support combustion, an excess of it, it is well known, will, in some cases, extinguish a burning body, as expeditiously as water; and from this circumstance it may be inferred, that for ignition, the air requires to be heated, as well as the combustible body. We may also infer, that the intensity of heat produced by the union of the two bodies, will be proportional to the excess with which their united heats, exceed their mean heat of ignition.

Having had occasion, during the past winter, to warm two warehouses, of different sizes, and it being necessary that the temperature should be permanent during the night season, two cylinder sheet iron stoves of ordinary construction, of different sizes, and lined with fire brick, were procured, which were supplied with Lehigh coal.

The construction of the stoves, being favourable to apply on a large scale, what I had found so advantageous in my experiment stove, there being considerable space between the grate and the bottom of the ash pan, this space was converted into a reservoir for heating the air, by closing the apertures usually made for its admission in the front of the ash pan. During the igniting process, the ash pan was drawn out, but when this was effected, it was closed as perfectly as its construction would admit, leaving only the small crevices at its junction with the body of the stove for the admission of air; and although the largest stove usually contained more than half a bushel of coal, this supply of air, was found sufficient for producing intense combustion; and the quantity of coal remaining on the grate, unconsumed, was found to be much less, than when the stove was supplied with a larger quantity of air; a very important saving was thus made in the heat, by diminishing the quantity, and the velocity with which the current of heated air passed into the chimney. Very important improvements may be made in the construction of sheet iron stoves, for burning anthracite coal; and if provision is made for supplying the burning body with *intensely heated air*, any required quantity of coal may be consumed, and the present manner of lining them with thick brick, may be entirely dispensed with, by substituting either thin tiles, or a thin coating of clay lute, sufficient to preserve the iron from fusion or oxidation; and as this would present less obstruction to the speedy communication of the heat generated, to the air of the room, consequently less would escape into the chimney.

In examining the construction of the open parlour grate, we do not find in it one entire quality, possessed by the close stove; the only one which bears any approach to similarity, is that three sides of the

grate are lined with fire brick, but as the fourth is almost wholly exposed, its utility is thereby defeated.

It is admitted that the combustion is very perfect and rapid, when the sheet iron door, or "*blower*," as it is technically termed, is applied to close the front of the grate; and this must be a necessary consequence, as its application transforms the open grate, into a powerful *air furnace*, by which the space for the admission of air, is very much reduced; and the air is probably, reduced in quantity, this not being compensated by its increased velocity, and as the blower defends the body of coal in front, from the cold air to which it was before exposed, the required elevation in temperature is effected, and maintained without difficulty.

It is only by radiation, that any heat is imparted to the room from coal consumed in open grates, and as the radiated heat is known to be very small, from the surface of that portion of coal which is exposed to the front or open part of the grate, the amount of heat imparted to the room, would not probably be diminished, but rather increased, by using a thin plate of cast iron for the front of the grate, by which the difficulty of consuming small quantities of coal, would be very much diminished; and this would not be less agreeable in its appearance than the equally *sombre* aspect presented by the unignited coal in the front of the generality of small grates, and particularly as the top of the coal would be exposed to view, and present a more luminous appearance.

Although iron is a good conductor of heat, the plate suggested, would become sufficiently heated, to maintain the temperature of the coal necessary to carry on the combustion of the surface exposed to it, with the exception of the points actually in contact with it, which would be unimportant; and this being the case, its conducting power would, in other respects, be obviously advantageous, and no danger of melting the iron, in this situation, need be apprehended. If, however, danger from melting or oxidation of the iron is feared, as a flat plate of iron could not be permanently covered with any composition of clay, it should be made circular, and defended at the top and bottom by a flange projecting on the inside, the required thickness of the clay. In addition to the plate suggested to cover the front of the grate, a still further improvement might be made, by enclosing the ash pit also, both of which might be done with one plate of iron, and the grate for sustaining the coal might rest upon cleats projecting from the interior, taking care to give sufficient room for the expansion of the grate, to prevent its being pressed outwards. A door for the removal of ashes, and the admission of air, would be required, by which the necessary quantity of air could be admitted without an excess. This construction would also be favourable for heating the air which is to supply the combustible body; the advantage of which must be obvious, when we reflect on the necessity of cooling the burning body, as little as possible. By the greater expansion of the air, the quantity which comes in contact with the burning body, would be less in excess, at any one time, and better adapted to attain the object; the contact being more frequent, from its increased

velocity, the quantity actually united in any given time, would probably be greater, and more heat would consequently be produced. This construction, besides the advantages already stated, would be more cleanly than the open grate, would not require the blower, and could also be made use of for culinary purposes, which is a very desirable object to be attained.

The construction of many grates is very objectionable, in an important particular not yet noticed; which is, making the receptacle for the coal of greater length, than it has breadth or depth, by which the body of coal is not as much heated, and requires to be replenished more frequently, to maintain the relative position of the coal, necessary to continue the combustion. A much better shape, and which would require less coal at any one time, would be in the proportions of twelve inches deep, to eight inches square at the top, and gradually diminished to six inches at the bottom, by which the heat generated in the combustion of the coal at the lower part of the grate, in its passage to escape into the chimney, would come in contact with nearly the whole body of coal, and keep it heated, which cannot be the case in the former shape, supposing the contents of the two grates, and the coal in each to be equal; and if we suppose them to be only *half filled* with coal, the position of that in the deep grate, although less in quantity, will be very favourable for combustion, while that in the shallow grate, from the unfavourable situation in which it is placed, would scarcely burn at all. The advantage of placing the body of coal in a deep grate, as described, may be illustrated by the well known fact, that a stick of wood burns much more rapidly in a vertical, than in a horizontal position, and for the reason already assigned.

Being well aware of the strong predilection in favour of those constructions which will permit the burning body to be seen, which, with other reasons, prevent the use of close stoves in many instances, and particularly where elegance is required; the necessity is apparent, that some new construction should be devised, which can be substituted for the open grate, and which will obviate the difficulty, not only of consuming anthracite coal in small quantities, for rooms of small dimensions, but, the still greater objection generally made to its use, that the quantity cannot be varied to meet the changes in the temperature of the atmosphere.

In the plan which I will venture to suggest, a partial compromise must be made in the first particular stated, but all the others may be realized.

In those instances where simplicity of construction is required, take a cylinder, or rather an inverted conical frustum, of cast iron, of any required thickness, and diameter; and of sufficient height, to form the receptacle for the coal and ashes; insert a grate at a sufficient height from the bottom, to leave the required room for the ash pit, which should be provided with a door to remove the ashes and unconsumed coal, as usual in close stoves, and, also, to regulate the admission of air, which may be heated as in those stoves. This cylinder may be bricked in the ordinary manner on the outside; and this

can be done with greater facility than for the grate, and the cylinder will remain more permanently fixed, as it will rest on the hearth. From the satisfactory experiments which have been made in double cylinder stoves, in which the interior cylinder is made of cast iron, without any coating of clay, it is not probable that this construction would require it. In those instances in which beauty of construction must be consulted, the ornamental parts or appendages to the open grate may be added; the only change suggested, being the substitution of a cylinder, or other more desirable shape, of cast iron, in place of the open grate.

Having sufficiently, and, perhaps, tediously expatiated upon the particular circumstances necessary to be attended to, in the construction of any apparatus, intended for the combustion of anthracite coal, in small quantities; those whose business it is to construct such articles, will apply any suggestions which may be considered as valuable.

Before closing my paper, I cannot forbear making a few desultory remarks; and, first, on the commonly received opinion, that the "draught" of a chimney, or, more properly, the current of air through it, has greater velocity under one degree of atmospheric pressure than under another, and that this is the cause why a combustible body burns better at one time than at another.

That the velocity of the current cannot be greater under one degree of atmospheric pressure, than under another, *cæteris paribus*, may be satisfactorily shown, by supposing a room, with one window open, and in which, there is a fire-place and chimney, and that the temperature of the air in the room, and that within the chimney, is the same as the temperature of the atmosphere; in this case, no current of air would be found to pass either up or down the chimney, because the pressure of the column of air in the room, would be counterbalanced by the equal pressure of the column of air within the chimney, and, consequently, both must remain stationary. If the temperature of the air within the chimney, be elevated by any means, it expands, and becomes specifically lighter, and an ascending current will be produced; but if the same elevation of temperature remain, and we suppose any change, however great, in the pressure of the atmosphere, still as that change must, of necessity, operate on both columns of air, the velocity of the current, must consequently remain the same. The current of air through a chimney, being wholly an artificial production, its velocity will always be proportional to the elevation of its *temperature*, above that of the exterior air; the column of air in the chimney, being thereby rendered lighter than the exterior column, yields to its superior pressure, and thus the current is established.

If the air in the room is warmer than that in the chimney, a descending current will be produced; which shows the propriety of closing, during the winter season, those fire-places not used, to prevent the descent of cold air and smoke, from the adjoining flues; and the advantage of leaving them open during the hot season, when the exterior air is known to be at a lower temperature than that of the rooms in which they are situated.

In a chimney, which is in use, and properly supplied with air, the

existence of counter currents, spoken of by some writers on this subject, appears to be an illusion, produced by eddies in the air, at the sides of the chimney, as it enters from the room; it would be difficult to assign any satisfactory cause for such an effect, under the circumstances described.

In tight rooms, where fire-places are left open, and are not in use, counter currents will exist, so long as difference in temperature exists, between the air of the room, and the external atmosphere.

In those instances where the room is too tight to admit air, in sufficient quantity, to supply the current necessary to take off the smoke, a descending current is produced, and, as a necessary consequence, the smoke is driven into the room. The passage of the external air through the small crevices of the room, is not only diminished by the increased friction which it sustains, in passing through a large number of crevices, instead of one only of equal capacity, but the pressure necessary to the ascent of the smoke is absolutely prevented from exerting its full influence in raising the column of air within the chimney. If we open a window, this air, which before was the heavier column, will become the lighter; and consequently the current will be inverted, and the evil be thereby instantly corrected.

It is not my intention to notice the various causes which operate to produce what are termed "bad draughts" to chimneys; there is one however of considerable importance, which will be noticed. Chimneys which are new, are found very frequently, if not invariably, to smoke, when an attempt is made to use them before they have become perfectly dry. This being attributed to their bad construction, alterations are, in many cases, made, without knowing the true cause of the evil; which will generally be found to be entirely owing to the chimneys not being dry. The materials of which they are composed being damp, they are consequently good conductors of heat, and unless very large fires are made, it it difficult to elevate the temperature of the air, within them, sufficiently, to produce an ascending current; but when the chimney has become dry, and is covered with carbonaceous matter, it presents a bad conducting surface, and, if then found to smoke, it may be attributed to its bad construction; for which, however, no necessity exists in any case, save that the highly important class of artisans, who wield the trowel, have, too generally, disregarded science in their craft.

A sufficient quantity of air must be admitted into every room, to supply the demands of respiration, and of combustion; but any excess is injurious. The usual manner of admitting air for these purposes, through the joints or crevices of the doors, windows, and other parts of the room, appears very objectionable; as the cold air, thus admitted, is very annoying in its passage to the fire-place, particularly to those seated near the doors or windows. Now, these inconveniences may be entirely avoided, and all parts of the room rendered equally comfortable, by furnishing it, as is now done in some instances, with a supply-pipe, near the fire-place, for the admission of air. In this pipe there should be a valve, to regulate the quantity of air admitted; by this means the pressure of the external air, at the joints, or crevi-

ces, may not only be wholly taken off, but an outward current produced, through the crevices at the higher parts of the room.

The objection which has been made to this manner of admitting the air, that it does not change the air in the room sufficiently for respiration, appears to be gratuitous; and has been disproved by experience, in rooms of ordinary size, when not unusually crowded.

An additional improvement, to obviate the inconvenience experienced in overheated or crowded rooms, would be to furnish a ventilator in the chimney, near the ceiling; but the most rational plan, in these cases, would be to remove the cause, by diminishing the fire.

Having shown very clearly, during the preceding remarks, that combustion going on better at one time than at another, cannot be owing to any change in the velocity of the current within a chimney, in consequence of changes in the pressure of the atmosphere, it becomes obligatory on me, as an objector to this opinion, to assign a more satisfactory cause.

The fact is admitted, that combustible bodies generally burn better, when the barometer is at 30, than when it is at 28 inches, other circumstances being similar. The principal cause of this, appears to be, that the air is then generally drier, and better adapted to produce rapid combustion, having less aqueous vapour mechanically mixed with it. Now moist air retards combustion, and cools the burning body, more than dry air, because it possesses a greater capacity for heat, and, consequently, requires more from the burning body to raise its temperature to the point of ignition. In chimney fire-places, it is generally observed, that wood fires burn most rapidly in cold weather; and, even while the air of the room is quite cold, they are known to burn very well. This fact will probably be urged, to disprove the necessity of heating the air, to produce more complete combustion in anthracite coal. It should be recollected, however, that wood ignites at a much lower temperature, and, that in very cold weather, a much larger quantity is required to be in combustion at one time, than in moderate weather; and, consequently, that the air within a few feet of the fire, and before it comes in contact with it, is more heated than it is at the same distance in moderate weather, when less fire is required.

The intense heat produced by an air furnace, does not appear to be, in consequence of an increase in the volume of air, as those furnaces which are said to have the strongest "draught," will be found to have the most contracted throats. But, by thus contracting the throat, the friction of the air is increased, and its velocity being also increased, the sound which is said to denote a strong "draught," follows, as a necessary consequence. The air being very much expanded from its increase in temperature, and its rapid escape in large volume, being prevented by the contraction of the throat, the contact with the combustible is not only prolonged, but the real quantity in contact, at any one time, may be supposed to be considerably diminished; yet, this contact being more frequent and rapid, the union is more perfect, and, consequently, more intense heat is produced.

The superior light of an Argand lamp, is, probably, in consequence

of surrounding the burner with a glass chimney, by which the current of air is considerably elevated in its temperature, and the volume admitted, diminished, and not increased, as is generally supposed. Whether its increased velocity through the chimney is advantageous in the process of combustion, when abstractedly considered, may be questionable; but, it is evidently advantageous in dissipating the products of combustion, or rather, of imperfect combustion, which would otherwise remain longer in contact with the flame. If the chimney be removed from the burner, the flame will be increased to double its former length, yet the light will be pale, and the quantity emitted, much lessened. When the burner is surrounded by the glass chimney, if the wick remain at the same height, the strength of light required, can be better regulated by the quantity of air admitted, than in any other manner; and for this purpose, these lamps should be furnished with delicate valves, as the most intense light will not be produced when the largest quantity of air is admitted.

The advantage of elevating the temperature of the air, is demonstrated by the increased intensity of light, which is produced by the button sometimes used in these lamps.

Table exhibiting the results of experiments made to determine the comparative loss of heat sustained by using apparatus of different constructions, for the combustion of fuel.

Description of Apparatus used.	Time the room was maintained at the same temperature, in the combustion of equal weights of fuel, compared with apparatus No. 9.	Weight of fuel required by each apparatus, to maintain an equal temperature in the room, and during the same time, compared with No. 9.
No. 1. CHIMNEY FIRE-PLACE, of ordinary construction, for burning wood, . .	10	1000
2. OPEN PARLOUR GRATE, of ordinary construction, for burning anthracite coal, ...	18	555
3. OPEN FRANKLIN STOVE, with one elbow joint, and 5 feet of six inch pipe placed vertically, the fire-place being closed with a fire-board, ...	37	270
4. CAST IRON TEN PLATE STOVE, with one elbow joint, and five feet of four inch pipe, placed horizontally, entering the fire-board, ...	45	222
5. SHEET IRON CYLINDER STOVE, the interior surface coated with clay lute, with one elbow joint, and 5 feet of two inch pipe, placed horizontally, entering the fire-board, ...	67	149
6. SHEET IRON CYLINDER STOVE, as before described, with 13½ feet of two inch pipe, in which there was 3 elbow joints, the whole placed as follows: 3½ feet horizontally, 5 feet vertically, for an ascending current, and 5 feet vertically, for a descending current, entering the fire-board, ...	78	128
7. SHEET IRON CYLINDER STOVE, as before described, with 13½ feet of two inch pipe, in which there was 3 elbow joints, placed as follows: nine inches vertically, and 12¾ feet horizontally, entering the fire-board, ...	82	122
8. SHEET IRON CYLINDER STOVE, as before described, with nine elbow joints, measuring 13½ feet of two inch pipe, entering the fire-board, . . .	95	105
9. SHEET IRON CYLINDER STOVE, as before described, with 42 feet of two inch pipe, as used in the course of experiments on fuel, ...	100	100

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. 4.

BY P. A. BROWNE, ESQ.

On Mechanics' Liens.

In the last number of these essays, I commenced the consideration of the question, What is the nature of the *preference* given? and examined the operation of a previous *mortgage;* I shall now enquire

As regards a subsequent Mortgage.

Rule 1. If the Mortgage is given *after* the *commencement* of the *building*, the mechanics and material men have the prior claim.

All the debts contracted for or in the erecting and constructing a building, without regard to the particular period of time that the work was done, or materials were found, have in point of preference relation back to the *day of the commencement of the building.* The words are "before any lien, which originated subsequent to the *commencement* of the said house or other building:" hence it becomes important to enquire what is the *commencement* of a *building.*

Rule 2. The *recommencement* of a house after a slight interval of suspension of building, is not a *commencement* within the meaning of this act, and therefore

If the owner of an *unfinished* house sell it, and takes a mortgage for the purchase money, which is immediately recorded, the mechanics and material men who are soon after employed to *finish* the building, shall be preferred to the mortgage.

That the above decision comes within the *letter* of law, no one could deny, for the building was *originally* commenced before the judgment. But it was contended that according to the true meaning and spirit of the act, the *commencement* of the completion of the house was, as far as respected the lien creditors concerned in the completion, the *commencement* of *the building.* And of this opinion was Yates, Justice, in the case of The American Fire Insurance Company *v.* Pringle: but Tilghman, C. J. and Breckenridge, J. were of a different opinion. 2d S. and R. 138.

Rule 3. But if instead of proceeding as stated in the above rule, the house had been finished sufficiently for particular purposes, as for instance, for a warehouse or a store, but not for a dwelling house, and it had remained in that situation for years, during which time it had been mortgaged, and afterwards it had been completely finished, in that case the mortgage would have been preferred to the lien creditors concerned in the finishing.

The above rule may be fairly collected from the opinion given by the C. J. in the American Fire Insurance Company *v* Pringle.*

* Perhaps it may be expected of me to point out what particular *act* is the commencement of the building. This may not be so easily done as is anticipated.

For instance, suppose frames, sashes, doors, floor-boards, &c. are prepared for a building at the carpenter's shop; that at a subsequent day the cellar or foundation is dug, and at another day, still later, the first stone is laid. When,

Where there are two funds.

It is a principle of equity that a person having *two* funds, out of which to receive his debt, shall not, by his choice, disappoint another having but *one*; and if, therefore, a mortgage creditor has two or more premises mortgaged to him to secure the payment of his debt, and upon one of them mechanics and material men erect a building, the court will oblige him to take his debt out of the premises *not* built upon, if sufficient, and leave the other for the lien creditors.

This was the case of the Olympic Theatre, where the gable end of an old building was torn down, and a building was erected adjoining on that side, and opening thereto, on another lot, the Court directed two mortgages which were given on the *two lots* previously to the commencement of the building, to be paid out of the proceeds of the *first lot*, leaving the value of the new building to the lien creditors.

As regards a Previous Judgment.

*Rule 1. The same rule, as in the mortgage case, will hold, with respect to a judgment obtained *prior to the commencement* of the building, even though the builder at the time of the contraction of the debts to the mechanics and material men, had only an *equitable* interest in the lot, and acquired the legal estate afterwards.

It was contended that the judgment in the first instance was a lien on the *equitable interest* only, and not on the legal estate which came to the builder after the lien of the mechanics had attached, and therefore that they had the preference. But the court considered this argument in the same light as the Supreme Court did the similar one in Lyle *v.* Ducomb, and gave the preference to the judgment creditor.

See the case of John Vandevender, 2d Browne's rep. 304.

Rule 2. But where the builder acquired both legal and equitable

I ask, did this building commence, within the meaning of the act of Assembly? The beginning to make the frames, &c. at the shop is *literally* the commencement of a building. The digging the foundation or cellar is not the commencement of the *erection* of the building, but a *preparation* thereto; the laying of the *first foundation stone* is the act which has always been commemorated as the commencement of a building. And hence it is that in many instances, it is attended with much form and ceremony. But neither a consideration of the *literal* meaning, nor a recurrence to the ceremonies used on public occasions, removes our difficulties nor solves the question we have supposed. In order to do these, we must have a recurrence to the Act of Assembly. We must endeavour to give such a construction to the act as will work no injustice or inconvenience to any one. This will be very difficult. Justice to the community at large seems to require that the building should be said to be *commenced* at the time of some act publicly done upon the premises, that by viewing the same they may know that the *building has commenced*, and may be put upon their guard against the mechanics' liens.

But on the other hand, if the preference is to those judgments and mortgages only which originated after this public act on the premises, the lumber merchant who previously furnishes lumber at the carpenter's shop, when there was no mortgage or judgment, may be deprived of the benefit of his claim by a mortgage or judgment given between the time of his so furnishing his materials and the public act done on the premises as aforesaid; yet the supreme court have decided that for lumber, furnished at the carpenter's shop, a lien is created.

This question has not been agitated before any of our Courts, and I feel very reluctant to venture an opinion.

estate *after* the date of a judgment against him, and proceeded to erect a building, in doing which, he contracted debts, to mechanics and material men, they were preferred to such judgment creditor.

The distinction in this case arises upon the rule of law that a judgment does not bind *after acquired property*.

This will be found to be decided in the same case of John Vandevender, 2d Browne's rep. 304.

Another lot, let to another person on terms similar to those above recited, was assigned to Vandevender after the date of the judgments: and the court gave the proceeds of that house and lot to the lien creditors.

ON INERTIA.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir—I am aware of having said more in my former communication on Inertia, than can easily be established; and should it turn out a little hyperbolical, still many of my namesakes, among your readers, may be benefitted by learning how near my assertion comes to the truth.

Had I said, that the gravitating force of matter is, of necessity, opposed by an equal degree of force, under all circumstances, whether a body be at rest or falling, and that when no other force is present, *Inertia* is always *at home* to perform the office, and in general, that *force* is always opposed by *force* of equal energy; I presume I should have been consistent with the established theory of Inertia: but then I question whether any one would have been seriously disposed to controvert it. But I assert, that, *a body falling in vacuo, supported by nothing, is still as truly supported from falling as when resting upon a table.*

Suppose an unresisting body to be subjected to the action of a constant force, indefinitely small, the consequence would be uniform motion, and infinite velocity; the same would be the result, supposing the body to be influenced by two opposing constant forces, of unequal energy; for the less would annul so much of the greater, and the surplus would be a single force; but here we have a single force acting upon nothing, to which I object.

It appears then that less than a constant force, even the slightest possible impulse, would communicate to an unresisting body, infinite velocity; and if we consider that the force would only have to run away with itself, it will be found abundantly sufficient.

How can motion be produced at all, unless the moving force be greater than the resistance, is a question that naturally suggests itself; I consider the question fairly answered, by asking how *rest* can be produced upon the same principle, by friction, &c. without admitting the argument advanced by some, that moving bodies incline to rest.

The difficulty I conceive to arise from confounding the terms power and force, when they evidently mean very different things; for example, power is sometimes used to express simple force, as in fulcrum

power and weight, and sometimes to express the compound of force, time, and distance, or momentum, as in horse power, &c.

That a *power* producing motion, must be greater than the resisting force, I admit, and that action and re-action are equal, every one admits: it is necessary, therefore, to explain what I understand by power and force.

The momentum of a body in motion, is properly called the power of that body, to persevere in its present state; (and I shall show presently, that, in space, no force is exerted in continuing the motion uniform,) and the *momentum* of a body at rest, is the power of that body to maintain its present state; and I think it unnecessary to prove that it will not require holding.

Now it happens that all bodies upon the surface of the earth, which we are accustomed to consider at perfect rest, and consequently not attended with any degree of force, are only relatively so; that in fact they are in a state of rapid motion; and that a cannon ball projected due west, with the ordinary velocity, would only move slower than before—that is, slower than the earth's surface, and if its apparent velocity were sufficiently increased, it would then be at rest.

Bodies, then, in a state of uniform motion, as well as those at rest, have power to maintain their present state, distinct from force, which is only the measure of the loss of that power, and which, in regard to Inertia, is always equal to the force impressed.

When a heavy body is supported by a prop, the force of gravity is exactly balanced by the re-action of the prop, and if the prop be suddenly struck away, the body commences yielding its power of rest to the force of gravity; and this power, which at first supports the body as completely as the prop, gradually diminishes, whilst the force by which it endeavours to resist a change of state, remains constant, and equal to gravity; hence accelerated motion by a constant force: and again, when a heavy body (or rather a body possessing Inertia,) is projected upward, it continues to move beyond the projectile force, by its momentum, or power of moving, this power is gradually diminished and eventually destroyed, while the force by which it endeavours to resist a change of state, remains constant, and equal to the force of gravity to the end; hence the reverse of accelerated motion, by a constant force.

If I have not proved my point, I have shown that an unresisting body falls with infinitely greater velocity than one possessing Inertia, by the constant action of gravity, which is perhaps near enough for

Your friend and servant,

SEMI DOCTUS.

OF TANNING, LEATHER-DRESSING, DYING, &c.

(Continued from page 230.)

ON CURRYING LEATHER.

The common mode of currying leather for shoes, boots, &c. consists in first softening the hides, as they come from the tan-pit, part-

ly by soaking in water, partly by mechanical means, and then impregnating the leather with some kind of oil, by which means, it is rendered much more impervious to moisture, and proper to protect the feet from the inclemency of the seasons. The process, in a few words, is the following: the hide is first soaked thoroughly in water, then placed on a polished wooden beam, with the flesh side outwards, and pared with a broad sharp knife, till all the inequalities are removed, and it is reduced to the required thinness. It is then again washed and rubbed with a polished stone; and while still wet, it is besmeared with currier's oil, generally fish-oil, or a mixture of this, and tallow. When hung up to dry, the moisture evaporates, and the oil, which cannot be dissipated by mere exposure, gradually takes the place of the moisture, and penetrates deeply into the pores of the leather. It is then dried, either in the sun, or in a stoved room.

Blackening the leather, is also a part of the currier's business, which is done on the grain side, simply by rubbing with an iron liquor; but on the flesh side, with a mixture of lamp-black and oil.

Shammoyed Leather.

This is generally sheep or doe's-skin, prepared in the way already mentioned, viz. by dressing, liming, &c. This forms the common wash-leather, breeches-leather, &c. and is the only kind, which, when dyed, will bear washing, without the colour being materially injured.

Common boot-leather, as usually prepared, is still, in some degree, pervious to water, by long exposure to wet; and therefore fishermen, wild-fowl shooters, and those whose employment or amusement leads them to be long on wet ground, usually prepare their boots with an additional dressing of some oily or resinous matter.

Mixtures to render Leather Water Proof.

The punt-shooters in Cambridgeshire, and the adjoining fenny parts of England, use the following mixture, with very good effect.* Melt together, in an earthen pipkin, half a pound of tallow, 4 oz. of hogs-lard, 2 oz. of turpentine, and as much bees-wax; make the boots thoroughly dry and warm, and rub in this mixture well, with a little tow, as hot as the hand can bear; or else hold the boots over a very gentle fire, till the leather has thoroughly imbibed it. Another mixture for the same purpose, and used by fishermen, is, bees-wax, Burgundy pitch, and turpentine, of each 2 oz.; tallow, 4 oz.; or, half a pound of bees-wax, a quarter of a pound of resin, and a quarter of a pound of beef-suet. In all cases, the boots must be quite dry, and the mixture applied very warm.

It only remains, on the subject of leather, to notice, very shortly, some of the most remarkable kinds of leather, prepared in foreign countries; for the general methods of making leather resemble each other, very closely, in every part of the globe.

The process for the real Morocco Leather, as prepared from goat-skins, at Fez and Tetuan, is thus described by M. Brouffonet.† The

* Daniel's Rural Sports.

† Bulletin des Sciences.

skins are first cleansed, the hair taken off, limed and reduced with bran, nearly in the same way, already described, for the English Morocco leather. After coming from the bran, they are thrown into a second bath, made of white figs, mixed with water, which is thereby rendered slimy and fermentable. In this bath, the skins remain four or five days, when they are thoroughly salted with *sal-gem* (or rock salt) alone, (and not with salt and alum;) after which they are fit to receive the dye; which, for the red, is cochineal and alum; and for the yellow, pomegranate bark and alum. The skins are then tanned, dressed, suppled with a little oil, and dried.

Russia Leather.

Much excellent leather, of every kind, is prepared in different parts of the Russian empire. The preparation of the fine Russia leather, so well known, for its quality, and for its peculiar smell, is described at large in Mr. Tooke's "View of the Russian Empire,"* to which we must refer our readers, for the minuter particulars. In general, it may be stated, that the hides are first put into a weak alkaline ley, to loosen the hair, and then scraped upon a beam; then, (if calves,) are reduced by dogs' dung, and a sour oatmeal bath; then tanned with great care, *and frequent handling*. The bark used here is seldom oak; but where it can be got, the bark of the black willow; or, if this cannot be had, birch-bark. They are then dyed either red or black, these being the two colours most esteemed. For the red, the hide is first soaked in alum-water, and then dyed with Brazil-wood. The black is given, as usual, with an iron liquor. The leather is then smeared with *birch-tar*, which gives the peculiar smell, so much prized, (and which, when used for book-binding, has the valuable property of protecting the book from worms,) and is finished by various other manipulations. The streaked or barred surface, is given to the leather, by a very heavy steel cylinder, wound around with wires being passed over it.

(TO BE CONTINUED.)

ON VARIOUS PREPARATIONS OF CARMINE.†

Carmine, according to the opinions of MM. Pelletier and Caventou, is a triple compound, formed by the union of the colouring substance, and an animal matter contained in the cochineal, with an acid; which is added to effect precipitation. The preparation of this article, is still somewhat involved in mystery; for the consumption of it being limited, very few persons are employed in its manufacture; and the original material, the cochineal, being always at a very high price, experiments of this kind, become expensive. It is nevertheless to be presumed, that, assisted by the information afforded by MM. Pelletier and Caventou, it will now be easy, for those who wish to pay attention to this species of manufacture, to succeed in discovering the secret. We must observe, however, that success appears principally to depend, on a certain dexterity, which habit alone can

* Vol. III. page 514.

† From the *Dictionnaire Technologique.*

confer. It is not sufficient to have a good receipt, in order to succeed: it is likewise requisite, that the eye be sufficiently accustomed to distinguish when the colour of the bath, has attained the highest degree of beauty. This operation requires, likewise, that the manufacturer be well versed in the method of stopping the action of the heat, at the proper moment. After these preliminary observations, I shall proceed to transcribe some of the most approved recipes, and such as I have had executed with success, under my own eye.

Various sorts of carmine are sold at the colour shops, which are distinguished by the order of their numbers, and are of a relative value. The difference arises from two causes; either from the proportion of alumine added to it, in the precipitation, or from a certain quantity of vermillion mixed with it. In the first case, the colour is weakened: in the second, it does not retain the same brilliancy. It is always easy to perceive the proportion of the mixture, by the property which pure carmine possesses, of dissolving in ammonia. All the foreign matters remain untouched; and their proportions may be estimated, by drying the residuum.

Common Carmine.

1 pound of powdered cochineal.
3½ drachms of sub-carbonate of potash.
8 drachms of alum in powder.
3½ drachms of isinglass.

The cochineal is first boiled with the potash, in a copper boiler, containing five pails of water: the effervescence is stopped, with cold water.

After having boiled for some minutes, the boiler is removed from the fire, and placed on a table, so inclined, that the liquor may be easily poured off.

The powdered alum is then thrown in, and the decoction stirred; when it immediately changes its colour, and turns to a more brilliant tint. In about a quarter of an hour, the cochineal is deposited at the bottom, and the liquid is as clear as if it had been filtered. It contains the colouring matter, and probably a little alum in suspension.

The liquor is then decanted into another boiler, of the same size, and set on the fire; adding to it, isinglass, dissolved in water, and passed through a sieve.

At the moment of ebullition, the carmine is seen rising to the surface of the bath; and a coagulum is formed, similar to that which takes place in the clarifications made with the whites of eggs.

The boiler must be withdrawn from the fire, and the bath be stirred up with a spatula.

In fifteen or twenty minutes, the carmine is deposited: the liquor is then decanted; and the precipitate laid to drain, upon a very fine sieve.

Manner of Preparing the Isinglass.

After having cut it into small shreds, it must be allowed to remain in water for one night; during which time it will swell prodigiously,

and absorb a large portion of water: it is then put into a proper vessel, and, by means of heat, reduced to a transparent jelly, which instantly melts on being put into hot water.

Similar recipes may be found in many works; but, instead of isinglass, the whites of eggs, and sometimes even the whites and yolks together, are prescribed.

If the operation has been properly performed, the carmine when dry, will easily break between the fingers.

The more the pot-ash is carbonated, the more friable is the carmine.

What remains, after the precipitation of the carmine, is still greatly coloured; and may be advantageously employed in the preparation of red lakes.

Fine Carmine, known at Paris by the name of English Carmine.

Four pails-full of river-water, are made to boil in a large copper vessel: two pounds of hot water are drawn off, and passed through a very fine sieve, into an earthen vessel containing five eggs, which have been previously beaten up together with their shells: this forms a kind of emulsion, which is to be preserved apart.

A filtered ley, made of ten drachms of soda of Alicant, dissolved in four pounds of boiling water, is then poured into the vessel; and, at the same time, a pound and three quarters of cochineal, grossly powdered, is added: this is to be kept constantly stirred with a brush having a long handle, and allowed to boil for half an hour: the vessel is then removed from the fire, and fifteen drachms of pulverized Roman alum are added; and it is once more stirred up with the brush; then left at rest for ten or twelve minutes, till it is seen that the violet colour, has changed to a very deep scarlet red. The liquid is then decanted into a boiler, and the aforesaid emulsion, added to it; after which, it must be boiled up again. The carmine is then poured upon a fine linen cloth, extended upon a frame or stretcher. The red liquid, which passes through, is received into a wooden vessel, and is employed in the preparation of lakes. This operation, in all other respects terminates like the former. The carmine is reduced to powder, passed through a fine sieve, and preserved in tin boxes.

Superfine Carmine; termed "Madame Cenette's, of Amsterdam."

Six pails-full of river-water are put into a boiler, and set on the fire. At the instant when boiling commences, two pounds of cochineal, finely powdered, are added. After two hours' boiling, three ounces of pure nitre are put to it; and, presently afterwards, four ounces of salt of sorrel. After allowing it to boil ten minutes longer, the boiler is removed from the fire, and left at rest for at least four hours. The water is drawn from the carmine, with a siphon, to be distributed into several earthen vessels, which remain for three weeks, upon a table or bench. In a short time, a thin skin of mouldiness forms upon the top, which is removed, with a small sponge tied to the end of a stick: the water is then drawn off by a siphon, which may be plunged to the bottom of the vessels; for the carmine is so

firmly attached to the vessels, that it seems to form a part of them. This carmine, when dried in the shade, is almost too brilliant for the eye to endure.

(TO BE CONTINUED.)

Method of Preserving Iron Tanks from Oxydation.

The inventor, who is a Naval Officer in the French service, employs a composition of resin and olive oil, well mixed with ground bricks, which he mixes to the consistence of paste. He renders the resin adhesive to the interior of the casks or tanks, by melting it with the olive oil, which the iron absorbs; upon this it easily spreads by the application of heat; the bricks give solidity to the composition, without destroying its adhesive quality. This coating, when used for the interior of the tank, cannot be dissolved, or absorb water, but, on the contrary, is rendered more durable; neither is the composition liable to be affected by the atmosphere, when outwardly applied, and it preserves the iron from oxydating for a very great length of time. The inventor announces that he has employed this composition for many years, upon casks in the French navy, and also on the iron hoops, which do not the least oxydate, after having been treated by it.

[*London Jour.*

On the manufacture of Glue, or Size, for the use of Weavers, Paper-hanging manufacturers, &c.

Glue is made from hides, skins, and pelts; the skin of the ears, legs, &c.; and the older the animals producing them, the better.

Hide-roundings are the best material for this purpose, viz. the clippings of hides, which have only been limed; as leather which has been tanned, or dressed in oil, is of no value for glue or size.*

The proportion of their value, for this use, is nearly as follows:—112 lbs. of the hide-roundings are equal to making 56 lbs. of glue; the same quantity of chamois-leather or glovers' clippings, not oiled nor tanned, or of alumed or whittawed leather, to 40 lbs. of glue; of hare and rabbit skins, (which are never limed, and are mostly used by buckram-stiffeners and linen-dyers, in consequence of their not having any lime or alum in them,) to 35 lbs. of glue; also the same quantity of fellmongers' shreds yield from 25 to 28 lbs. of glue; and of parchment slips or cuttings, from 14 to 16 lbs.

A great deal, however, depends upon the various articles enumerated, being perfectly free from lime, dust, or dirt, their perfect state of dryness, and their good condition.

The expenses of boiling them into glue, are much reduced when the various articles have been soaked in water for 24 hours, previous to boiling them in other fresh water.

* Except for the use of the *black paper-case makers*, who use *tanned* leather for making their glue. See p. 115.

The quantity of water, must be regulated by the strength of the glue or size required; allowing one pint of water, for an ounce of glue, or 2 gals. for a pound of glue, for single size.

The hide-roundings require one gallon of water for 16 oz.; alumed leather, chamois leather and glovers' clippings, 1 gal. per 20 oz.; hare and rabbit skins, 1 gal. per 24 oz.; fellmongers' shreds, 1 gal. per 28 oz.; and parchment cuttings, 1 gal. per 50 oz.

The exact quantity of water, ought first to be put into the boiler, according to the quantity of size intended to be made; and when the article to be boiled into size, is added, the depth or quantity of liquid required to be constantly maintained, till the gelatine is extracted by the boiling, will be correctly ascertained; and any visible waste occasioned in the boiler, during the operation, must be continually supplied, by adding the necessary quantity of water; or, otherwise, considerable time will be lost in the process.

An iron pan or boiler is much better than any other, provided that care is taken to add cold water, by a little at a time, while the boiling is continued. And it is also necessary to have an iron grating placed inside the boiler, in order to prevent the article from burning to the bottom of it, and to lessen the time and trouble required in frequently stirring it. [*Manufacturers' Assistant.*

On the fallacy of the prevailing opinion, that a Candle burns away the faster for being snuffed. By BENJAMIN BABINGTON, *Esq.*, M. P.

It is a commonly received opinion, that a candle, when regularly snuffed, burns away much faster than when suffered to burn without snuffing; and hence people submit to the very great loss of light, occasioned by that neglect.

Mr. J. I. Hawkins, many years ago, made experiments, by which he proved, that a candle does not burn away the faster, in consequence of being snuffed; and we are glad to find his experience again confirmed, by the following accurate experiments, made by Mr. Babington.

He had six candles of the best tallow, cast in the same mould, with wicks of twelve threads; these he burned for one hour, in an apartment in which the air was unagitated, and at a temperature of 55°. He first performed the experiment by snuffing them every ten minutes, and then without snuffing them at all; being desirous to ascertain what difference in the combustion, the snuffing would cause.

The loss, in weight, of those which were snuffed, varied from 100 to 106 grains; those which had not been snuffed, from 97 to 106 grains. It thus appeared that the consumption of material, in a tallow candle snuffed at intervals of ten minutes, is only 2.75 per cent. more than in a candle not snuffed; *a difference very inconsiderable, compared with the difference of light produced.* [*Tech. Rep.*

On French Paper, made of the Boom, or Cross-fibres, of Hemp and Flax.

We have lately been favoured by a friend, with specimens of coloured papers, made of the above materials, procured *in the improved French manufactures, of hemp and flax, without water-rotting or fermentation*, and which were of yellow and cream colours; they were rather tender, however, and seemed to require a mixture of longer fibres, to give them sufficient strength and durability.

This is making a much better use of the fibrous part of the boom, or refuse of flax and hemp, than merely converting it into manure, as is done in this country; and, when the improved methods of treating flax and hemp by machinery, instead of water-rotting them, shall have become common in this country, and Ireland, as we hope and trust they will in time do, such materials may be obtained in considerable quantities, and form a valuable addition to the paper maker's resources. [*Tech. Rep.*

On a French Luting used in Propagating Fruit trees, by Grafting them.

The best luting wherewithal to cover the newly grafted scions, is composed of equal quantities of train oil and rosin, prepared in the following manner:—First, melt the rosin in an earthen vessel, then pour in the oil, and mix them well; to be applied when cold, with a painter's brush. The composition is used in the north-west part of France (Bretagne) with general success. It has this advantage, that it never cracks, nor admits rain or wind to the grafts, which is the usual cause of their failing. It is more expeditiously put on, than the common clay covering, and looks much neater; but what renders it more useful, is, that the grafts covered with the composition, seldom fail. Scions laid under earth, or steeped in water, for a few days, grow better than those taken fresh from the parent tree. Grafting cherry or pear trees should not be delayed later than St. Patrick's day. [*New Monthly Mag.*

A Method of Fixing Crayon Colours.—By James Smithson, Esq.

(TO THE EDITORS OF THE ANNALS OF PHILOSOPHY.)

London, Aug. 23, 1825.

Gentlemen—Wishing to transport a crayon portrait to a distance, for the sake of the likeness, but without the frame and glass, which were bulky and heavy, I applied to a man, from whom I expected information, for a method of fixing the colours. He had heard of milk being spread with a brush over them, but I really did not conceive this process of sufficient promise, to be disposed to make trial of it.

I had myself read of fixing crayon colours, by sprinkling solution of isinglass, from a brush, upon them; but to this too, I apprehended

the objections of tediousness, of dirty operation, and perhaps of incomplete result.

On thinking on the subject, the first idea which presented itself to me, was that of gum-water applied to the *back* of the picture; but as it was drawn on sized blue paper pasted on canvass, there seemed little prospect of this fluid penetrating. But an oil would do so, and a drying one would accomplish my object. I applied drying oil diluted with spirit of turpentine; after a day or two when this was grown dry, I spread a coat of the mixture over the front of the picture, and my crayon drawing became an oil painting.

On the Dutch Process of making Elastic Composition Inking-Rollers for Printing; now frequently used instead of Balls.

To eight pounds of transparent glue, add as much rain or river water, as will just cover it; and stir it occasionally during seven or eight hours. After standing for twenty-four hours, and all the water is absorbed, submit it to the action of heat, in a water-bath, and the glue will soon be dissolved. Remove it from the fire as soon as a froth is seen to rise; and mix with it seven pounds of molasses, which has been previously made tolerably hot: stir the composition well together, in the water-bath, over the fire, but without suffering it to boil. After being thus exposed to the heat for half an hour, and frequently well stirred, it should be withdrawn from over the fire, and allowed to cool for a short time, previous to pouring it into a cylindrical mould, made of tin, tinned sheet iron, or copper, having a wooden cylinder previously supported in its centre, by means of its end-pivots or gudgeons.

After remaining in the mould, at least eight or ten hours, in winter, and a longer time in summer, the roller is to be taken out of the mould, by means of a cord fastened to one of the gudgeons, and passed over a strong pulley, fixed to the ceiling; but care must always be taken, that the cylinder is drawn out slowly, from the mould.

Old rollers are re-cast in the same manner; first taking care to wash them with a strong alkaline ley, and adding a small quantity of water and molasses. The best mode, however, of making use of the old composition, is, by mixing it with some new, made of two pounds of glue, and four pounds of molasses.

Economical Candles.

Doctor Ŏ'Neil, of Comber, has discovered a process, by which lard may be used for making candles; he renders this substance superior to the Russia tallow, and not so expensive. The lard, after having undergone his process, resembles white wax or spermaceti. Candles made of this prepared substance, burn with a brilliancy superior to common candles, and, it is said, even to gas; they are free from any unpleasant smell, and do not feel greasy to the touch, nor give off any smoke: they burn much longer than candles of the same weight, and by a slight alteration in the process, they can be rendered yellow or of any other colour, or as white as snow, which neither light, air,

or smoke can alter. We should be happy to hear the particulars of this process, but have some notion that it is the subject of a forthcoming patent here. [*London Jour.*

EFFECTS OF HOT WATER ON FLOWERS.

The following is deserving of record, as an addition to what has hitherto been discovered on the subject of vegetable physiology; and as enabling the lovers of flowers, to prolong for a day, the enjoyment of their short lived beauty.

Most flowers begin to fade after being kept 24 hours in water, a few may exist longer by substituting fresh water repeatedly; but all the most *fugacious*, (such as the poppy, and one or two others excepted) may be completely restored by the use of *hot water*. For this purpose, place the flowers in scalding water, deep enough to cover about one-third of the length of the stem, and by the time the water has become cold, the flowers will have become erect and fresh; then cut off the ends, and put them into cold water.

ON GILDING, SILVERING AND TINNING.

FROM NICHOLSON'S OPERATIVE MECHANIC.

Continued from page 25.

Oil gilding on Wood.—The wood must first be covered or primed, by two or three coatings of boiled linseed oil and carbonate of lead, in order to fill up the pores, and conceal the irregularities of the surface, occasioned by the veins in the wood. When the priming is quite dry, a thin coat of gold size must be laid on. This is prepared by grinding together some red oxide of lead, with the thickest drying oil that can be procured, and the older the better; that it may work freely, it is to be mixed, previously to being used, with a little oil of turpentine, till it is brought to a proper consistence. If the gold size is good, it will be sufficiently dry in twelve hours, more or less, to allow the artist to proceed to the last part of the process, which is the application of the gold. For this purpose, a leaf of gold is spread on a cushion (formed by a few folds of flannel, secured by a tight covering of leather,) on a piece of wood, about eight inches square, and is cut into strips of a proper size, by a blunt pallet knife; each strip being then taken upon the point of a fine brush, is applied to the part intended to be gilded, and is then gently pressed down by a ball of soft cotton; the gold immediately adheres to the sticky surface of the size, and after a few minutes, the dexterous application of a large camel's hair brush, sweeps away the loose particles of the gold leaf, without disturbing the rest. In a day or two, the size will be completely dried, and the operation will be finished.

The advantages of this method of gilding, are, that it is very simple, very durable, and not readily injured by changes of weather, even when exposed to the open air; and when soiled, it may be cleaned by a little warm water, and a soft brush; its chief employment is in out-door work. Its disadvantage is, that it cannot be burnished, and therefore wants the high lustre produced by the following method.

To gild by burnishing.—This operation is chiefly performed on picture frames, mouldings, beadings, and fine stucco work. The surface to be gilt must be carefully covered with a strong size, made by boiling down pieces of white leather, or clippings of parchment, till they are reduced to a stiff jelly; this coating being dried, eight or ten more must be applied, consisting of the same size, mixed with fine Paris plaster or washed chalk; when a sufficient number of layers have been put on, varying according to the nature of the work, and the whole is become quite dry, a moderately thick layer must be applied, composed of size and Armenian bole, or yellow oxide of lead: while this last is yet moist, the gold leaf is to be put on in the usual manner; it will immediately adhere on being pressed by the cotton ball, and before the size is become perfectly dry, those parts which are intended to be the most brilliant are to be carefully burnished by an agate, or a dog's tooth, fixed in a handle.

In order to save the labour of burnishing, it is a common, but bad practice, slightly to burnish the brilliant parts, and to deaden the rest by drawing a brush over them dipped in size; the required contrast between the polished, and the unpolished gold, is indeed thus obtained; but the general effect is much inferior to that produced in the regular way, and the smallest drop of water, falling on the sized part, occasions a stain. This kind of gilding, can only be applied on in-door work; as rain, and even a considerable degree of dampness, will occasion the gold to peel off. When dirty, it may be cleaned by a soft brush, with hot spirit of wine, or oil of turpentine.

To gild Copper, &c. by Amalgam.—Immerse a very clean, bright piece of copper, in a diluted solution of nitrate of mercury. By the affinity of copper for nitric acid, the mercury will be precipitated: now spread the amalgam of gold, rather thinly, over the coat of mercury, just given to the copper. This coat unites with the amalgam, but of course will remain on the copper. Now place the piece or pieces so operated on, in a clean oven or furnace, where there is no smoke. If the heat is a little greater than 600°, the mercury of the amalgam will be volatilized, and the copper will be beautifully gilt.

In the large way of gilding, the furnaces are so contrived that the volatilized mercury is again condensed, and preserved for further use, so that there is no loss in the operation. There is also a contrivance by which the volatile particles of mercury are prevented from injuring the gilders.

To Gild Steel.—Pour some of the ethereal solution of gold, into a wine glass, and dip therein the blade of a new pen-knife, lancet, or razor; withdraw the instrument, and allow the ether to evaporate. The blade will be found to be covered by a very beautiful coat of gold. A clean rag, or small piece of very dry sponge, may be dipped in the ether, and used to moisten the blade, with the same result.

In this case there is no occasion to pour the liquid into a glass, which must undoubtedly lose by evaporation; but the rag or sponge may be moistened by it, by applying either to the mouth of the phial. This coating of gold will remain on the steel for a great length of time, and will preserve it from rusting.

This is the way in which swords and other cutlery are ornamented.

Lancets too, are in this way gilded with great advantage, to secure them from rust.

To heighten the colour of Yellow Gold.

6 oz. saltpetre,
2 oz. copperas,
1 oz. white vitriol, and
1 oz. alum.

If it be wanted redder, a small portion of blue vitriol must be added. These are to be well mixed, and dissolved in water as the colour is wanted.

To heighten the colour of Green Gold.

1 oz. 10 dwts. saltpetre,
1 oz. 4 dwts. sal ammoniac,
1 oz. 4 dwts. Roman vitriol, and
18 dwts. verdigris.

Mix them well together, and dissolve a portion in water, as occasion requires.

The work must be dipped in these compositions, applied to a proper heat to burn them off, and then quenched in water or vinegar.

To heighten the colour of Red Gold.

To 4 oz. melted yellow wax, add
$1\frac{1}{2}$ oz. red ochre in fine powder,
$1\frac{1}{2}$ oz. verdigris calcined till it yield no fumes, and
$\frac{1}{2}$ oz. calcined borax.

It is necessary to calcine the verdigris, or else, by the heat applied in burning the wax, the vinegar becomes so concentrated as to corrode the surfaces, and make it appear speckled.

To separate Gold, from Gilt-Copper and Silver.—Apply a solution of borax, in water, to the gilt surface, with a fine brush, and sprinkle over it some fine powdered sulphur. Make the piece red hot, and quench it in water. The gold may be easily wiped off with a scratch-brush, and recovered by testing it with lead.

Gold is taken from the surface of silver by spreading over it a paste, made of powdered sal ammoniac, with aqua fortis, and heating it till the matter smokes, and is nearly dry; when the gold may be separated by rubbing it with a scratch-brush.

To silver by Heat. No. 1.—Dissolve an ounce of pure silver in aqua fortis, and precipitate it with common salt; to which add $\frac{1}{2}$lb. of sal ammoniac, sandiver, and white vitriol, and $\frac{1}{4}$ oz. of sublimate.

No. 2.—Dissolve an ounce of pure silver in aqua fortis; precipitate it with common salt, and add, after washing, 6 ounces of common salt, 3 ounces each of sandiver and white vitriol, and $\frac{1}{4}$ ounce of sublimate.

These are to be ground into a paste, upon a fine stone, with a muller; the substance to be silvered must be rubbed over with a sufficient quantity of the paste, and exposed to a proper degree of heat. Where the silver runs, it is taken from the fire, and dipped into weak spirit of salt, to clean it.

Silvering on Gilt Work, by Amalgamation.—Silver will not attach

itself to any metal by amalgamation, unless it be first gilt. The process is the same as gilding in colours, only no acid should be used.

To silver in the Cold Way.

No. 1.—2 dr. tartar,
2 dr. common salt,
$\frac{1}{2}$ dr. of alum, and
20 grs. of silver, precipitated from the nitrous acid by copper.

Make them into a paste with a little water. This is to be rubbed on the surface to be silvered, with a cork, &c.

No. 2.—Dissolve pure silver in aqua fortis, and precipitate the silver with common salt; make this precipitate into a paste, by adding a little more salt and cream of tartar. It is applied as in the former method.

To Silver Copper Ingots.—The principal difficulties in plating copper ingots, are, to bring the surfaces of the copper and silver into fusion at the same time, and to prevent the copper from scaling; for which purposes fluxes are used. The surface of the copper on which the silver is to be fixed, must be made flat, by filing, and should be left rough. The silver is first annealed, and afterwards pickled in weak spirit of salt; it is planished, and then scraped on the surface to be fitted on the copper. These prepared surfaces, are anointed with a solution of borax, or strewed with fine powdered borax itself, and then confined in contact with each other, by binding wire. When they are exposed to a sufficient degree of heat, the flux causes the surfaces to fuse at the same time, and after they become cold, they are found firmly united.

Copper may likewise be plated by heating it, and burnishing leaf silver upon it; so may iron and brass. This process is called French Plating.

To separate the Silver from Plated Copper.—This process is applied to recover the silver, from the plated metal, which has been rolled down for buttons, toys, &c. without destroying any large portion of the copper. For this purpose a menstruum is composed of 3 pounds of oil of vitriol, $1\frac{1}{2}$ ounce of nitre, and a pound of water. The plated metal is boiled in it, till the silver is dissolved, and then the silver is recovered by throwing common salt into the solution.

To Plate Iron.—Iron may be plated by three different modes.

1st. By polishing the surface very clean, and level, with a burnisher; and afterwards, by exposing it to a blueing heat, a leaf of silver is properly placed, and carefully burnished down. This is repeated till a sufficient number of leaves is applied, to give the silver a proper body.

2nd. By the use of a solder. Slips of thin solder are placed between the iron and silver, with a little flux, and secured together by binding wire. It is then placed in a clear fire, and continued in it, till the solder melts; when it is taken out, and on cooling, is found to adhere firmly.

And 3d. By tinning the iron first, and uniting the silver by the intermedia of slips of rolled tin, brought into fusion in a gentle heat.

(TO BE CONTINUED.)

List of Patents for Inventions and Improvements issued in the United States, from December 12, 1825, *to March* 10, 1826.

1825.

Improvement in preventing doors, &c. from being too tight, December 12, Daniel Fraser, New York.

In making wooden screws, Dec. 12, James Lynch, Pulaski, Giles County, Tennessee.

In the machine for cutting paper, Dec. 18, John M'Clintic and George Taber, Chambersburg, Penn.

In making Piano Fortes, Dec. 17, Alpheus Babcock, Boston, Mass.

In the shingle mill, for sawing shingles, Dec. 17, Ephraim Parker, Fitzwilliam, New Hampshire.

In the machine for cleaning rice, Dec. 21, Alexander Shinie, Charleston, S. C.

In the machine for making mortices, Dec. 22, Ezra Ripley, Troy, N. York.

Being a fresh water dry dock, Dec. 22, Levi H. Clarke, and L. M. Wiss, N. York.

In the cast iron box for the hubs of wheels, Dec. 28, Jeremiah Wilt, Chambersburg, Penn.

In the system of lotteries, Dec. 28, Francis W. Dana, Boston, Mass.

In rotting flax and hemp by steam, Dec. 28, Achilles Chinn, Harrison county, Kentucky.

In the mode of propelling carriages, Dec. 28, Thomas Blanchard, Springfield, Mass.

In the application of steam generally, Dec. 29, Michael Musselman, Phelps, N. York.

In the mode of planking wool hats, &c. Dec. 31, Laban L. Macomber, Bath, Maine.

In pressing and smoothing unburnt bricks, Dec. 31, Thomas Norcross, Hallowell, Maine.

In raising boats from canals, &c. Dec. 31, Elisha Turner, Rochester, N. Y.

1826.

In refrigerators for Distilleries, January 6, L. Chs. & Phil. Bodmann, Baltimore.

In the machine for thrashing grain, Jan. 10, William Small, Augusta, Maine.

In the joints for bedsteads, Jan. 11, John Mitchel, Harrisburg, Penn.

In the washing machine, Jan. 11, Oliver Deane, Walpole, Mass.

In the water cement, Jan. 11, Simeon Guilford, Lebanon, Penn.

In retarding carriages when descending hills, Jan. 16, Ezra Slifer, Boonsborough, Maryland.

In the machine for thrashing grain, Jan. 16, Jacob A. Heermance, Redhook, N. York.

In the horizontal cotton and wool spinner, Jan. 16, J. S. & B. J. Billings, Moreau, N. York.

In extending motion, and multiplying power, Jan. 16, William Kendall, Jun. Waterville, Maine.

In the machinery for sawing boards, Jan. 16, William Kendall, Jun. Waterville, Maine.

In the stove, &c. for cooking, Jan. 19, John Bonis, Baltimore.

In the machine for mashing, in distilleries, Jan. 19, William Whitney, Rochester, N. York.

In the tincture for curing corns, Jan. 20, Elisha Smith, N. Brunswick, New Jersey.

In the mode of bushing sheaves and blocks, Jan. 23, Theodore and Daniel Curtis, Washington, D. C.

In the machine for mixing mortar, Jan. 23, John M. Brookings, Wiscasset, Maine.

In the washing machine, Jan. 25, Willard Foster, Oswego, N. York.

In the machine for sawing shingles, Jan. 25, Willard Foster, Oswego, N. Y

In making ornamenting rolls, Jan. 26, David H. Mason, Philadelphia.

In the mode of drawing water, Jan. 27, Jeremiah Dexter, Salisbury, Conn.

In the mode of obtaining water from wells, Jan. 27, Junius Smith, London, England.

In the plough, Jan. 28, Stephen M'Cormick, Fauquier, Virginia.

In the temples used in weaving cloth, Jan. 30, Orsemus M. Stillman, Brookfield, Madison county, N. Y.

In the cooking stove, February 1, David Little, Hagerstown, Md.

In cleaning the seed from cotton, Feb. 3, Jesse Reed, Marshfield, Mass.

In pumps, Feb. 4, Silvanus Russell, Olean, N. York.

In constructing railways for raising vessels, Feb. 8, Amasa Miller, New-London, Conn.

In the saw mill, Feb. 8, Israel Johnson, Jr. Villenovia, N. York.

In digging canals, Feb. 10, Jeremiah Brainerd, Rome, N. York.

In the machine for pressing hay, Feb. 15, Nathan Whitney, Augusta, Maine.

In the machine for planting cotton, &c. Feb. 15, Frs. H. Smith, Richmond, Virginia.

In the steam pump, Feb. 16. George W. Long, U. S. Artillery, Old Point Comfort.

In making brooms, Feb. 15, Adam Sclater, Oxford Township, Penn.

In the machine for pressing hops, Feb. 17, Joseph Wilson, Otsego, N. York.

In the machine for thrashing grain, Feb 18, Joseph Potter, Reading, Penn.

In the machine for thrashing grain, Feb. 21, Daniel Hurlbut, N. Etheredge, and J. M'Combs, Herkimer county, N. York.

Being a tube picker used in weaving, Feb. 21, Benjamin Holbrook, Providence, R. I.

In bedsteads, Feb. 21, Peter Breasted, Green county, N. York.

Called the "family mill," Feb. 23, David Flagg, Jr. Gardiner, Maine.

In the steam still, Feb. 23, James G. Foley, Harrisburg, Penn.

In the power loom for weaving wire, Feb. 23, John S. Gustin, New York.

In the ship railway dock, Feb. 24, John Thomas, New York.

On the old method of tanning, March 1, Leonard Jacobs, Richmond, Va.

In the construction of smiths' vices, March 2, Calvin Wing, Gardiner, Maine.

In the machine for printing, March 2, Daniel Treadwell, Boston.

In the machine for roping and spinning, March 3, J. R. Wheeler, and J. B. Wheeler, Galway, Saratoga county, N. Y.

In the 30 hours wooden wheel'd clocks, March 4, Eli Terry, Plymouth, Conn.

On his former patent, March 4, do. do.

In fire-proof wrought iron chests, March 7, Jesse Delano, New York.

In the machine for rubbing marble, March 7, Elijah Ferris, West Chester, N. York.

In the washing machine, March 8, Edward Thurston, Burlington, Vermont.

In the steam engine, March 10, George Deming, Niagara, N. York.

In the machine for sewing leather, March 10, Henry Lye, Philadelphia.

In the machine for hulling rice, March 10, John L. Norton, New York.

List of New Patents in England, which have passed the Great Seal. since Jan. 23, 1826.

To R. Stevenson, Bridge Town, Warwickshire, engineer, for axletrees to remedy the extra friction on curves, to wagons, carts, and carriages, used on rail roads, trainways, and other public roads.—Jan. 23.

R. Rigg, Bowstead Hall, Cumberland, for a new condensing apparatus, to be used with the apparatus now in use for making vinegar.—Feb. 4.

J. C. Gamble, Dublin, chemist, for an apparatus for the concentration and crystallization of aluminous and other saline and crystallizable solutions; part of which apparatus may be applied to the general purposes of evaporation, distillation, inspissation, and desiccation, and especially to the generation of steam.—Feb. 7.

W. Mayhew, Union-street, Southwark, and W. White, Cheapside, hat manufacturers, for an improvement in the manufacture of hats.—Feb. 7.

H. Evans, harbour-master of the port of Holyhead, North Wales, for a method of rendering ships and other vessels, whether sailing or propelled by steam, more safe in cases of danger by leakage, bilging, or letting in water, than as at present constructed.—Feb. 7.

W. Chapman, Newcastle-upon-Tyne, civil engineer, for improved machinery for loading or unloading of ships, vessels, or craft.—Feb. 7.

B. Cook, Birmingham, brass-founder, for improvements in making files of various descriptions.—Feb. 7.

W. Warren, Crown-street, Finsbury-square, for improvements in the process of extracting from the peruvian bark, medicinal substances or properties, known by the name of quinine and cinctronine, and preparing the various salts to which these substances may serve as a basis.—Feb. 11.

J. L. Higgins, Oxford-street, for improvements in the construction of the masts, yards, sails, rigging of ships, and smaller vessels, and in the tackle used for working or navigating the same.—Feb. 11.

B. Newmarch, Cheltenham, and C. Bonner, Gloucester, brazier, for a mechanical invention to be applied for the purpose of suspending and securing windows, gates, doors, shutters, blinds, and other apparatus.—Feb. 18.

T. Walter, Luton, Bedfordshire, straw-hat manufacturer, for improvements in the manufacture of straw plat, for making bonnets, hats, and other articles.—Feb. 18.

C. Whitlaw, Bayswater Terrace, Paddington, medical botanist, for improvements in administering medicines by the agency of steam or vapour.—Feb. 18.

A. Buffum, Bridge-street, hat manufacturer, for improvements in the process of making, or manufacturing and dying, hats.—Feb. 18.

Philadelphia Society for Promoting Agriculture.

Stated Meeting, 5th month (May) 16, 1826.

On Motion Resolved, That the premium offered on the 17th of January last, by this Society, of fifty dollars or a gold medal of that value, for the greatest quantity of sewing silk made from cocoons of silk worms which have been bred in Pennsylvania, and fed on the white or Italian mulberry tree, be extended to New Jersey, within ten miles of Philadelphia.

Extract from the minutes.

W. S. WARDER, *Secretary.*

THE

FRANKLIN JOURNAL,

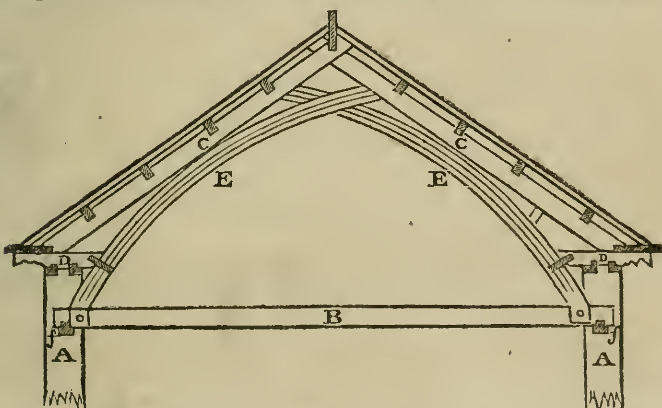
AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE MECHANIC ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

JUNE, 1826.

An improved construction of a Roof, by A. H. Holdsworth. Esq.



Sir,—Conceiving that every improvement of importance in house building, must necessarily be of some interest to the majority of your readers; and being desirous of contributing my feeble aid to the support of your valuable publication, I send you a sketch of an improved form of Roof, invented by A. H. Holdsworth, Esq.; for which that gentleman received the large silver medal from the Society of Arts. As an account of his invention is given in 'The Transactions of the Society,' in Mr. Holdsworth's own words; I shall avail myself of his observations in the description of it.

The advantages which this method affords, are the saving of a considerable proportion of the timber usually employed, and the gaining for useful purposes the whole space that is contained within the

roof. Mr. Holdsworth constructed a roof of this kind over the dwelling-house of a friend of his, and notwithstanding his walls were only six feet above his upper floor, he has obtained in consequence good lofty rooms, whilst the outside of his house appears very low; his barns, hay lofts, &c. are built on the same plan.

"A A, represents the walls of the house, and B one of the timbers of the uppermost floor, resting on the sleepers *f f*, which are let into the wall; over two other sleepers laid in the top of the wall, are fitted two pieces of wood D D. The principal rafters C C, forming each pair, are then secured at the bottom, into the pieces D D, and are fastened to each other at the top by iron pins. Each pair of the principal rafters C C, is supported by two arch pieces E E; these pieces are *in their grain*, and are formed on the plan recommended by Mr. Hookey, of the king's yard, at Woolwich, to whom the country is so much indebted for this method of converting the timber. They are cut lengthways, by a saw, into three pieces, to within two feet of one end, are then placed in a steam kiln, and boiled until they will bend freely, when they are fixed to a mould, and left to cool, after which a few pins of wood are driven through them to keep the pieces so cut from again flying open. The arch pieces will get a little out of shape when taken from the mould, but will be easily brought back, and when secured under the principal rafters, will fit the more firmly. The lower end of these arch pieces are inserted in the beam B of the floor, and therein firmly pinned, while at the top they cross one another, and each butts against its opposite rafter. They are further secured by iron straps to the short pieces D D, on which the principal rafters rest, thus preventing the latter from sinking and thrusting out the walls, and making the whole a stiff and complete framing, on which the longitudinal rafters, and transverse pieces are fastened in the usual manner.*

"The roofs of barns or other buildings that have only a ground floor, may be constructed in the same way, care being always taken to bring the feet of the arch-pieces so far down the wall as to give them a firm bearing.

"Mr. Holdsworth having already constructed several roofs of great widths on the plan described, expresses his entire confidence of being

* In the middle of a building, where four principal and as many arch pieces meet, and consequently cannot cross each other as represented in the enclosed drawing, Mr. Holdsworth employs a sort of short king-post, which is suspended to the principal rafters by their being morticed into it; and the upper ends of the four arch pieces are let into mortices at the lower end of the post, where they all meet and are secured.

In a common hay-loft, or cottage, the same advantages may be obtained by letting the principal rafters rest on short pieces of wood; which may, as before described, be attached by a strap of iron to another piece going from the beams of the floor to the middle of the principal rafter immediately under the couple beam, where it may be secured. It may be of straight timber; but in the country, where there is always crooked timber enough about a farm of no use for house work, this will be employed to greater advantage, as it will save what is of more value to the carpenter, and at the same time will give more space in the room.

able to apply the same principle to a roof of any given span for which timber of sufficient length could be procured.

"This elegant improvement, which does away with all those inconvenient timbers in roofs of the ordinary construction, called king-posts, queen-posts, braces, &c. &c. consequently leaves the whole space (as before observed,) which is usually employed to no useful purpose, for the making of good lofty rooms, besides effecting a considerable saving in timber. [*Register of Arts.*

Description of a Bow and Spring Rafter, by Mr. Smart.

Fig. 1.

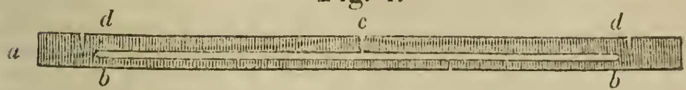
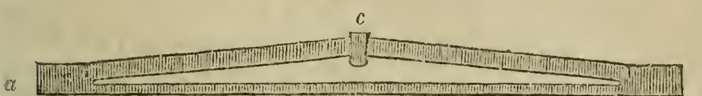


Fig. 2.



This very neat, simple and effectual method of constructing the rafters for a nearly flat roof, was invented by Mr. Smart, of the Ordnance Wharf, Westminster Bridge. The following communication, together with a model, was sent by him to the Society of Arts, for which he received its honorary reward.

"Having long been convinced of the great utility of flat roofs, especially in London and other great towns, where space is very valuable, I have for some time turned my attention to the discovery of the most economical and effectual method of constructing them. After various experiments, I ventured to put my plans in execution on a large scale, at the premises whence this letter is dated ; and the highly satisfactory result of this trial, induces me to communicate some particulars of it to the Society of Arts, &c. Over the rafters I nailed down very strong laths, with moderate intervals between each, and laid upon them a platform of bricks bedded in cement; the bricks are covered by a layer of foot tiles laid in cement, having the joints pointed with mastic cement, and their upper surfaces twice coated with linseed oil, laid on boiling hot. The roof, although on a superficial view it appears flat, has yet sufficient declination towards the sides to allow the free escape of water; and from an experience of several months, I have reason to be entirely satisfied with its soundness. Its cost is not more than half the price of lead, and the only objection that can be urged against it, is its weight. To counteract this, I have made an alteration in the form of my rafters, which I find to be effectual ; and a description of which I subjoin, as well as a model.

"I take a square spar of the usual size for a rafter, and by means of a circular saw, make an incision along it as represented in Fig. 1 ; I then make the cut *c*, at right angles to the former, and equi-dis-

tant from the two ends *a a*; lastly, I make the two cuts *d d*, taking out a thin wedge from each place. The two pieces *c d*, are then to be gently raised up till they form an angle of 10° or 12°, with the piece *b b;* and are secured in their place by the insertion of a key-wedge *e*, of seasoned oak, as represented in Fig. 2. It is obvious that a weight pressing on the key-wedge of this rafter, (the ends being properly supported) will be sustained till either the fibres of the wood forming the string are drawn asunder, or till the lateral cohesion of the wood forming the butt ends of the rafters are destroyed; at the same time there is no lateral pressure on the wall or other support."

"Ordnance Office, Westminster Bridge,

"April 24, 1824."

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*Observations on Alloys, or Mixtures of Metals.**

In Chemistry, and in the Arts, we generally mean by *alloys* the combination of two or more metals; but the alloys with mercury bear the particular name of *amalgams*. Thus, when we say, the amalgam of bismuth, the amalgam of silver, &c. we thereby understand the alloy of mercury with bismuth, of mercury with silver, &c.

The number of alloys known, and used, are very considerable: we will endeavour generally to explain their compositions. Many of them, however, form the principal objects of certain manufactures.

A metal will not alloy indifferently with other metals; there are a certain number with which it is impossible to form a union, whilst a marked affinity exists between others: but when the combination is possible, it appears susceptible of being effected in any required proportion; at least they have not found out, at present, any character which indicates the point of saturation; so that this kind of combination may be compared, in a certain degree, to the solutions of salts in water. Alloys, however, possess properties which do not appear to be derived from their component parts, and which denote that they are not merely simple mixtures.

Alloys, compared with the metals which enter into their composition, present the following characters.

In general, they are less ductile; and we know many instances of very soft metals, which, by their union, form an alloy exceedingly brittle. The contrary happens in respect to their hardness: this is, in general, more considerable; with the exception, however, of all kinds of amalgams.

It is very rare that the specific gravity of an alloy will be a mean between those of the metals alloyed; and, what is very remarkable, their density is sometimes less, and sometimes greater, than the mean density: thus the volume of an alloy is either less or greater than the sum of the volumes of its constituent parts. We will present our readers with a table, which we have extracted from the *Chimie Elémentaire*, of M. Thénard: this table comprises a great number of binary alloys, divided into two series; one whose density is greater, and the other less than the mean.

* From the *Dictionnaire Technologique.*

Alloys whose densities are *greater* than the mean densities of their constituent metals.	Alloys whose densities are *less* than the mean densities of their constituent metals.
Gold and zinc.	Gold and silver.
Gold and tin.	Gold and iron.
Gold and bismuth.	Gold and lead.
Gold and antimony.	Gold and copper.
Gold and cobalt.	Gold and iridium.
Silver and zinc.	Gold and nickel.
Silver and lead.	Silver and copper.
Silver and tin.	Copper and lead.
Silver and bismuth.	Iron and bismuth.
Silver and antimony.	Iron and antimony.
Copper and zinc.	Iron and lead.
Copper and tin.	Tin and lead.
Copper and palladium.	Tin and palladium.
Copper and bismuth.	Tin and antimony.
Lead and antimony.	Nickel and arsenic.
Platina and molybdena.	Zinc and antimony.
Palladium and bismuth.	

It is very difficult to foresee the degree of fusibility of an alloy; for it has not, as we may say, any analogy with the degree of fusibility of the metals composing it. We have a very remarkable example in the fusible alloy, which is composed of eight parts of bismuth, five of lead, and three of tin. This alloy, which melts at the temperature of boiling water, may be rendered still more fusible, by adding a small portion of mercury: it is then used for anatomical injections: the dentists likewise make use of it, to fill up the cavities of carious teeth.

The colours of alloys, also, do not depend in any manner upon the colours of the metals which are united together. Thus, the colour of copper, instead of being diminished by the addition of a certain proportion of zinc, is, on the contrary, singularly increased; whilst a very small quantity of silver is sufficient to cause the colour of gold entirely to disappear.

The foregoing observations clearly demonstrate that there is really a combination between those metals which alloy together.

There exist natural alloys; but we shall now only treat on those which are formed: and of these, only such as are in use.

In alloying metals with each other, we derive the same advantages as if we posessed a much greater number of primitive metallic substances, each possessing its peculiar qualities. Thus one alloy will form a metal possessing the property of being solid at the ordinary temperature, and, at the same time, experiencing fusibility in a greater degree than any other. Another alloy forms a brittle and sonorous metal, which may be employed in the manufacture of bells, cymbals, &c. Another will be susceptible of receiving the most beautiful polish, and become fit to be manufactured into metallic mirrors, &c. It is, then, in a manner, multiplying metals, and their uses, in multiplying alloys. This part of chemistry has not, perhaps, been

sufficiently cultivated, in all its applications. The labours of *Gellert* and *Black* have added a little to our knowledge on the subject. We know well, that such a metal will unite with such another; but not, in what respective proportions of their component parts the alloy will afford the most advantageous qualities: this is only known of a very small number: and the same observations may also be applicable to the ternary and quarternary alloys. How many combinations, indeed, of the metals recently discovered, have not been at all studied; as far, at least, as respects their utility; but of which, perhaps, the smallest quantity would be sufficient to give useful and even precious qualities to certain other metals! We have had a very striking example, in the attempts which have been made to imitate *wootz*.

There are some general rules in the making of alloys, which are indispensably necessary to be known, in order to ensure success. As alloys, then, can only be obtained by fusion, and as the requisite temperature to produce them may be that at which the metals may oxidate, it is essential to preserve them, as much as possible, from the action of the air. For this purpose, various means are employed, according as the metals to be alloyed are more or less fusible or oxidable. Thus, tin and lead, for example, require only to have a little resin, suet, or oil, thrown into the melting-pot, when the metals begin to fuse; and then to be stirred with a small iron rod. If any metallic portions should be oxided, they are immediately reduced by the hydrogen and the carbon of these combustible substances. If we would alloy iron with tin, this alloy requires a much more elevated temperature than the former, to bring it to a state of fusion, even with the aid of the tin, and the substances which we have above mentioned would both be burnt, before the alloy could be effected. We are obliged, in this case, therefore, to have recourse to a *flux*, which forms a kind of bath, entirely surrounding the metal, and thereby preserving it from coming into contact with the air. When it is supposed that the fusion is effected, the alloy must be well stirred together, to render all its parts perfectly homogeneous.

Whenever there exists a considerable difference in the specific gravities of the metals which we would combine, we frequently experience the greatest difficulty in obtaining an alloy perfectly similar in all its parts; each of the metals being apt to separate in the order of its density; which renders it necessary to stir it well, until the moment it is poured out. When we operate on large quantities, the length of time which the matter takes to cool is sometimes sufficient for this separation to manifest itself afresh. This inconvenience takes place, especially, in the founding of bells and pieces of artillery. If the alloy, however well it may have been mixed, does not present the desired uniformity, after the first founding, it is broken to pieces, and again submitted to the melting-pot. By this means the whole becomes completely homogeneous.

It is frequently found to be very difficult to alloy three or more metals together; either because one of them may be less fusible or more oxidable than the others; or, that the affinity which forms their union may not be sufficiently strong; in the latter case, we often

succeed best by not fusing each metal separately, as is usual; but by combining them two and two, and afterwards forming them into a single alloy. It is frequently very troublesome to alloy, in a direct manner, a small portion of iron with bronze; but if, instead of iron, we use tinned iron, the combination will be immediately effected, and the bronze, by this addition, will acquire its proper quality. Also, to render brass more fit for certain uses, it is requisite to add to it a small quantity of lead: but this cannot be effected in a direct manner; for, according to the observations of M. Chaudet, we should then succeed very imperfectly. It is therefore preferable, as he recommends, first to fuse the lead with zinc, because these two metals easily combine; and afterwards to add the copper to the first alloy, in order to obtain the desired result.

We have before observed, that the difference in fusibility is also an obstacle to a combination; and this obstacle is so powerful, that we sometimes derive from it great advantage, in decomposing certain alloys: this happens in the process of *liquation*. This operation is intended to separate any silver which may be united to copper; for which purpose they add a certain proportion of lead. There results an alloy, composed of very different elements, in respect to their fusibility: this alloy is exposed to a heat just sufficient to melt the lead, which liquefies, and carries with it almost the whole of the silver;—the difference in the oxidability then affording the means of separating one of these metals from the other.

These general observations we have thought necessary to give, on the making of alloys. We shall now make some remarks on some of the various alloys used in the Arts.

One of the most useful alloys (for it is chiefly on this account that we treat on the subject) is that of zinc and copper: it is more ductile and less oxidable than copper itself; and offers, in this point of view. very great advantages indeed: there is not any alloy more employed. This alloy may be made in various proportions; and, as it then assumes different qualities, different denominations are also assigned to it. Thus we know it by the names of yellow copper, brass, pinchbeck, *similor*, Prince Rupert's metal, Manheim gold, &c.

Copper and tin form, by their union, an alloy equally valuable, which is known by the names of bell-metal, bronze, gun-metal, &c. This alloy is manufactured on the large scale, for bells, pieces of cannon, &c. Gold and silver, in their pure states, are too soft to be manufactured into vessels and durable coin: they must be alloyed with a litte copper, in proportions regulated by law.

When we wish to unite various pieces of metal, it is done by the well-known process of soldering; which consists in uniting their surfaces by means of an alloy interposed, and which, of course, must be much more fusible than the metal which composes the article to be soldered. This solder, or alloy, must also be formed of metals susceptible of easy combination with those to be united. We see by this, that each metal requires a particular kind of solder: thus, the solder for gold vessels, or jewellery, is an alloy of gold and silver, or gold and copper; that for silver, an alloy of silver and copper; that

for copper is either of pure tin, for articles which are not intended to be set on the fire, or of an alloy which is called *hard solder*, which is composed of tin and copper:* the solders for tin and for lead are alloys of these two metals, &c. The respective proportions of the component parts of these alloys are greatly varied, according as a greater or less degree of fusibility is required: thus, for very delicate articles, the alloy is rendered as fusible as possible. For the purpose of economy, workmen in preparing their solder, frequently make use of the greatest proportion of that metal which is the cheapest. The solder known by the name of *plumber's solder* is composed of one part of tin, and two of lead.

In order to preserve certain metals from the action of the air, and from various other agents which might corrode them, they are covered with a metal less alterable, and which renders them fit for the construction of various instruments and utensils. This may be considered as a real alloy, but only at the point of contact of the two surfaces: in every other respect the two metals are perfectly independent of each other. This is, as it were, a solder without an intermedium. Tinning, gilding, and silvering, are of this kind. The two last are more frequently used as objects of luxury, than as preservatives.

We must observe, before terminating this article, that we cannot exactly apply what we have above stated to the silvering of glass; for here, one of the two metals being liquid, and the two layers excessively thin, they reciprocally penetrate, and mix together into an homogeneous mass. We well know that the silvering on glass answers quite a different purpose to any other preparation which we have mentioned; as, instead of this silvering preserving the surface to which it is applied, it is, on the contrary the plate of glass which guards it, and preserves to it that beautiful polish which prevents the luminous rays from penetrating, and causes them to be reflected from within.

A brazier of Paris, named *Biberel*, proposed, some years since, to substitute, in common tinning, instead of fine tin, an alloy made with eight parts of tin and one of iron. This process was far more advantageous than that formerly in use, and the tinning lasted for a much longer time. It appears, however, that the workmen entrusted to execute it, either did not understand the management of it, or were guilty of some great dishonesty. Certain it is, that this kind of tinning is no longer in use: it is, however, much to be lamented, that an invention so important and useful should be entirely abandoned.

It is extremely difficult to alloy iron and tin together; and it is therefore probable, that persons unaccustomed to this kind of operation would endeavour to use pure tin, expecting the tin to alloy with the iron. Perhaps the abandoning of the new process may be chiefly owing to this circumstance.

An alloy of iron and tin is obtained in this manner. The clippings

* The hard solder for copper, is generally formed of zinc and copper. [*Editor.*

of iron are to be put into a crucible, and covered all over with powdered glass: the crucible is then placed in a wind-furnace, and heated to a high red;—at this period the fine tin is plunged in the iron, and very soon melts: the mixture must then be briskly stirred together. It is again covered with ground glass, and the crucible closed. When the whole is completely red, it must receive another good stirring, then another heating, and afterwards be run into an ingot mould. It is very probable that still better success might be obtained by substituting *tinned iron*, instead of clippings of iron.

This alloy enters into fusion at a low red heat; and if it be brought into contact with the surface of a plate of copper slightly heated, with the assistance of sal-ammoniac it melts immediately, and may be spread over the surface by rubbing it with tow, as easily as if it were pure tin only.

Lead is much too soft to be employed for many purposes, but it readily attains whatever hardness may be desired, by alloying it with a greater or less quantity of antimony, according to the purpose for which it is designed. In the proportion of a sixth part of antimony, or even a twelfth part, the alloy is harder and more fusible than lead; still, however, preserving its malleability. When these two metals are combined, in the proportion of one of antimony and four of lead, it forms the basis of the metal employed in making printing-types. Each type-founder may somewhat vary his proportions; having, as we may say, his own peculiar receipt, of which he makes a secret. Those who sell at the lowest price use the greatest proportion of lead; but then the faces of the letters soon lose their sharpness; and, after being used a short time, the types give way under the press, and become what is called *battered*. When, on the contrary, a good and durable type is desired, we not only use the whole quantity of antimony mentioned, but also add a little copper.

The alloy made use of at Paris for water-cocks, is analogous to that which we have been describing; only the proportions of lead are greater: and when the antimony, best known by the workmen under the name of *regulus*, is dear, zinc is partly substituted for it. This metal, in fact, always gives lustre and hardness to lead, and even makes it somewhat sonorous.

Arsenic, alloyed with the greater part of the metals, even in a very small proportion, renders them extremely brittle, and liable to break: it also increases their fusibility. These alloys are easily decomposed, at a temperature more or less elevated; especially if the operation be performed in contact with the air. We derive great advantages from this property of arsenic in the manufacture of platina; the two metals are fused together, but the alloy is freed from the arsenic by a gradual calcination; and accordingly as the platina becomes porous, it is condensed by being submitted to a very strong pressure. But since the mineral acids have diminished in value, we prefer to treat the platina in the humid way, because the platina is hereby obtained much purer and more malleable.

In the manufacture of certain utensils, an alloy is made, to which the name of *white copper* is given: it is formed of nearly ten parts of copper and one of arsenic: it is obtained by directly fusing the arsenic with the copper, or treating it with arseniate of potash; always taking the precaution of properly defending the alloy, during its fusion, from the contact of the air. It is very seldom that the colour of the copper becomes completely extinct at the first fusion: it must then be returned into the melting pot, and a fresh quantity of arsenic be added; and, finally, we obtain a white alloy, resembling silver; but it is very brittle.

We shall now relate some new and very interesting experiments on the subject of *steel;*—the pursuit of which must not be abandoned, until the desired end is attained. The *Society of Encouragement* has set apart funds for these important researches; and has nominated an especial commission, who are indefatigable in their attentions to the subject. We have, therefore, great reason to hope that we shall soon see, in France, vast improvements in this branch of manufacture.

The following are the most important results, which have been obtained at present.

In England, Messrs. Stodart and Faraday have formed an alloy possessing all the characters of the best steel of Bombay. These chemists commenced their operations by forming a carburet of iron, which contained 94,36 of iron, and 5,64 of carbon: this carburet, powdered, and exposed to an extremely intense heat, in union with pure alumine, formed an alloy of a white colour, and of a very close grain. The proportion of carbon in it was so diminished, that it could scarcely be appreciated. This body had been replaced, in this experiment, by 6,4 of alumine, or probably by its base. Forty parts of this compound of iron and alumine, being fused with 700 parts of good steel, afforded a new alloy; which, on being corroded by acids, became damasked like *wootz*.

Steel and silver are very difficult to alloy; as, although, when in fusion, they may be homogeneous, yet they separate, the one from the other, on cooling; unless when these two metals are combined, in the proportion of 1 part of silver and 500 of steel; they then produce a perfect alloy, superior to the best steel of India. This result is too remarkable, not to be confirmed on the large scale.

The same authors also speak of an alloy, obtained by fusing equal parts of steel and platina, which was capable of receiving the finest polish, and was not susceptible of being tarnished by the action of the air. The colour of this alloy is the most brilliant and advantageous that can be desired for the manufacture of mirrors. Rhodium, combined with steel in the proportion of from one to two per cent., furnishes an alloy, of excessive hardness and tenacity.

In France, M. Bertier, Professor in the Royal School of the Mines, has obtained an alloy of chrome and steel, in the proportion of 0,010 of the latter, to 0,015 of the former. This alloy was very remarkable, for the facility with which it could be wrought; and for the beautiful silvery damask, which it furnished, on being corroded by sulphuric acid.

M. Boussingault, a mineralogical pupil in the School of *Saint Etienne*, has made a series of experiments; the result of which is, that silicum is a constituent part, and more essential to the existence of steel than even carbon. This ingenious scholar has repeated, with much care, the experiments of Clouet on the transformation of iron into steel, by means of a mixture of argil and calcareous carbonate; and has obtained the same result, by substituting pure lime for its carbonate,—that the steel obtained, in either case, does not contain any appreciable quantity of carbon, but much silicum. M. Boussingault has also assured us, that the iron, during its cementation, robs the charcoal of a portion of the silex which it contained.

If, as we have reason to believe, these experiments are correct, they merit our attention in all respects.

On rendering Fish Oil and Linseed Oil drying; and on making cheap Oil Paints. By Mr. T. Vanherman.

From the Transactions of the Society for the Encouragement of Arts, &c.

Having applied a great portion of my time, for several years past, to discover a method of preparing a cheap and durable composition for the defence and preservation of all work exposed to the inclemency of the weather, I have now the satisfaction of laying before the Society for the Encouragement of Arts, &c. specimens of some of the colours ready prepared for use, which will, I flatter myself, be found superior to all others for cheapness and durability, equal to any in beauty, and not be subject to blister or peel off from the heat of the sun.

The vehicle made use of for the said paints is fish-oil, the preparation of which is so simple, that, when known, gentlemen who have large concerns to paint, may have this composition of any colour manufactured, and laid on by their labourers.

I have sent a bottle of the prepared oil, also a number of patterns of paints, of various colours. The highest price of any does not exceed three-pence per pound, and many of them are so low as two-pence, in a state fit for use. I have likewise sent a pot of white lead, which has been ground with prepared fish-oil; and which, when thinned with linseed-oil, surpasses any white hitherto made use of for resisting all weathers, and retaining its whiteness. I hope my humble endeavours will merit the approbation of the Society, before whom I will, at any time they shall please to appoint, make the various experiments they may require.

Relying on your encouragement, I am, Gentlemen, with due respect, your most obedient humble servant,

Thomas Vanherman.

To refine one Ton of Cod, Whale, or Seal Oil, for Painting, the following ingredients are used.

One ton of fish oil, or 252 galls.	12 lbs. white copperas†
32 galls. of vinegar	12 galls. of linseed oil
12 lbs. litharge*	2 galls. of spirit of turpentine.

* The vitreous oxide of lead.

† Sulphate of zinc.

To prepare the Vinegar for the Oil.

Into a cask which will contain about forty gallons, put thirty-two gallons of good common vinegar; add to this twelve pounds of litharge, and twelve pounds of white copperas in powder; bung up the vessel, and shake and roll it well twice a day for a week, when it will be fit to put into a ton of whale, cod, or seal oil; (but the Southern whale oil is to be preferred, on account of its good colour, and having little or no smell;) shake and mix all together, when it may settle until the next day; then pour off the clear, which will be about seven-eighths of the whole. To this clear part add twelve gallons of linseed-oil, and two gallons of spirit of turpentine; shake them well together, and after the whole has settled two or three days, it will be fit to grind white-lead and all fine colours in; and when ground, they cannot be distinguished from those ground in linseed oil, unless by the superiority of their colours.

If the oil is wanted only for coarse purposes, the linseed-oil and spirit of turpentine may be added at the same time that the prepared vinegar is put in; and after being well shaken up, it is fit for immediate use, without being suffered to settle.

The vinegar is used to dissolve the litharge, and the copperas accelerates the solution and increases the drying quality.

The residue, or bottom, when settled, by the addition of half its quantity of fresh lime-water, forms an excellent oil for mixing with all the course paints for preserving outside work.

Note.—All colours, ground in the above oil, and used for inside work, must be thinned with linseed-oil and spirit of turpentine.

☞ The oil mixed with lime water, I call *incorporated oil.*

The method of preparing various impenetrable Paints.

First—*Subdued Green.*

Fresh lime-water, 6 gallons,	Wet blue, 20 do.
Road dust, finely sifted, 112lbs.	Residue of the oil, 3 gallons,
Whiting, 112lbs.	Yellow-ochre, in powder, 24lbs.
Blue-black, 30 do.	

This composition will weigh 368 pounds, which is scarcely one penny per pound. To render the above paint fit for use, to every eight pounds add one quart of the incorporated oil, and one quart of linseed-oil; and it will be found to be a paint with every requisite quality of beauty, durability, and cheapness; and, in this state of preparation, does not exceed two-pence half-penny per pound; whereas the coal-tar paint of the same colour is six-pence per pound.

The method of mixing the Ingredients for the Subdued Green.

First, pour six gallons of lime-water into a large tub, then throw in 112 pounds of whiting; stir it round well with a stirrer; let it settle for about an hour, and stir it again. Now you may put in the 112 pounds of road-dust, mix it well; then add the blue-black, after which, the yellow-ochre; and when all is tolerably blended, take it out of the tub, and put it on a large board or platform, and with a labourer's shovel, mix and work it about as they do mortar. Now

add the wet blue, which must be previously ground in the incorporated oil, (as it will not grind or mix with any other oil.) When this is added to the mass, you may begin to thin it with the incorporated oil, in the proportion of one quart to every eight pounds; and then with the linseed-oil, in the same proportion; and it is ready to be put into casks for use.

Lead Colour.

Whiting, 112lbs.	Road-dust, 56lbs.
Blue-black, 5 do.	Lime-water, 5 gallons,
Lead, ground in oil, 28 lbs.	Residue of the oil, $2\frac{1}{2}$ do.
Weight 256lbs.	

To the above add two gallons of the incorporated oil, and two gallons of linseed-oil to thin it for use, and it will not exceed the price of $1\frac{3}{4}$*d.* per pound.

Note.—The lime-water, whiting, road-dust, and blue-black, must be first mixed together; then add the ground lead, first blending it with two gallons and a half of the prepared fish-oil; after which thin the whole, with the two gallons of linseed oil, and two gallons of incorporated oil, and it will be fit for use. For garden-doors, and other work liable to be in constant use, a little spirit of turpentine may be added to the paint whilst laying on, which will have the desired effect.

Bright Green.

112lbs. yellow-ochre, in powder,	6 gallons lime-water,
168 do. road-dust,	4 do. fish-oil, prepared,
112 do. wet blue,	$7\frac{1}{2}$ do. incorporated oil,
10 do. blue-black,	$7\frac{1}{2}$ do. linseed-oil.
Weight 592lbs.	

This excellent bright-green paint does not exceed three-pence farthing per pound, ready to lay on; and the inventor challenges any colour-man or painter to produce a green, equal to it, for eighteen-pence per pound.

After painting, the colour left in the pot may be covered with water, to prevent it from skinning; and the brushes, as usual, should be cleaned with a painter's knife, and be kept under water.

A brighter green may be formed by omitting the blue-black; and

A lighter green may be made by the addition of ten pounds of ground white-lead.

A variety of greens may be obtained by varying the proportions of the blue and yellow.

Observe, that the wet blue must be ground with the incorporated oil, preparatory to its being mixed with the mass.

Stone Colour.

Lime-water, 4 gallons,	Prepared fish-oil, 2 gallons,
Whiting, 112lbs.	Incorporated oil, $3\frac{1}{2}$ do.
White-lead, ground, 28lbs.	Linseed-oil, $3\frac{1}{2}$ do.
Road-dust, 56lbs.	
Weight 293lbs.	

The above stone colour, fit for use, is not two-pence per pound.

Brown Red.

Lime-water, 8 gallons,	Four gallons of fish-oil,
Spanish brown, 112lbs.	Four do. incorporated oil,
Road-dust, 224lbs.	Four do. linseed-oil.
Weighs 501lbs.	

This most excellent paint is scarcely three-half pence per pound. The Spanish brown must be in powder.

A good chocolate colour, is made by the addition of blue-black in powder, or lamp-black, till the colour is to your mind; and

A light brown, may be formed by adding ground white-lead.

Note.—By ground-lead is meant white-lead ground in oil.

Yellow, is prepared with yellow-ochre in powder, in the same proportion as the Spanish brown.

Black, is also prepared in the same proportion, using lamp-black, or blue-black.

To Whiten Linseed-oil.

Take any quantity of linseed-oil, and, to every gallon, add two ounces of litharge; shake it up every day for fourteen days; then let it settle a day or two; pour off the clear into shallow pans, such as dripping pans, for instance, first putting half a pint of spirit of turpentine to each gallon: place it in the sun, and, in three days, it will be as white as nut oil.

This oil, before it is bleached, and without the spirit of turpentine, is far superior to the best boiled oil; there is no waste, and it has no offensive smell.

Note.—From experiments made, it appears that fine sand will not answer the purposes of road-dust in painting; and that this dry dust, collected in high-ways much travelled by horses and carriages, and afterwards finely sifted, is the article recommended, as possessing the properties required.

I here subjoin a receipt for a constant white, for the inside painting of houses; which paint, though not divested of smell in the operation, will become dry in four hours, and all smell be gone in that time.

A Constant White Paint.

To one gallon of spirit of turpentine, add two pounds of frankincense; let it simmer over a clear fire until dissolved; strain it, and bottle it for use. To one gallon of my bleached linseed-oil, add one quart of the above, shake them well together, and bottle them also. Let any quantity of white-lead be ground with spirit of turpentine very fine, then add a sufficient portion of the last mixture to it, until you find it fit for laying one. If in working, it grows thick, it must be thinned with spirit of turpentine. It is a flat or dead white.

Certificates of the superior excellence of the above paints accompany the original paper.

ON ENGRAVING.

(FROM THE MECHANIC'S GALLERY, BY C. F. PARTINGTON.)

History of the Art.

It has been truly observed, that, "among the various arts which belong to the gradual development of human ingenuity, and have decorated the fair fabric of civilized society, that of engraving is one of the most ancient." It was the earliest mode which the mind suggested, and the hand of man attained, of imparting useful information, and of displaying ornamental art: indeed the principal part of our knowledge relative to the otherwise dark regions of remote antiquity, has been transmitted by records engraven on stone or metal.

Turning, however, from the flowery field of antiquarian lore; it may be enough for our present purpose, to shew that the mechanical execution of the art had attained a considerable degree of perfection at a very early period, and an illustration of this fact will be found in the Babylonian bricks that have been preserved, and which bear evident marks of an operation, nearly similar to that of the graver.

The first accounts we meet with of engraving on copper is from some German annals, about the year 1450. The earliest copper-plate extant is dated 1461, which, notwithstanding its rudeness and imperfections, sufficiently evinces that the engraver was no stranger to the use of his instruments: and the copper-plate printer far from being unpractised in his art: from several other engravings of the same master, we may discover, that the printing of these plates had become a mechanical profession: the impressions are so clearly taken in every part, that it is a doubt whether they could be exceeded by the copper-plate printers of the present day, with all the conveniences they now possess, and the additional knowledge they must necessarily have acquired in the course of between three and four centuries.

"Hence," Mr. Strutt says, "we may fairly conclude, that if they were not the first specimens of the engraver's workmanship, they were much less the first efforts of the copper-plate printer's ability. It is likewise to be observed, that Martin Schoen, who is said, with great appearance of truth, to have worked from 1460 to 1486, was, apparently, the scholar of Stoltzhirs; for he followed his style of engraving, and copied from him a set of prints representing the Passion of our Saviour: now, allowing Stoltzhirs to have preceded his disciple only ten years, this carries the era of the art back to 1450, as was said above. There is no ground to suppose that it was known to the Italians till at least ten years afterwards. The earliest prints that are known to be their's, are a set of the seven planets, and an almanack, by way of frontispiece; on which are directions for finding Easter, from the year 1465 to 1517 inclusive: and we may be well assured that the engravings were not antedated, for the almanack, of course, became less and less valuable every year. In all probability, therefore, these prints must have been executed in the year 1464, which is only four years later than the Italians themselves lay claim to the art. The three earliest Italian engravers, are Finiguerra, Bo-

ticelli, and Baldini. If we are to refer these prints to any of the three, we shall naturally conclude them to be the work of Finiguerra or Baldini; for they are not equal either in drawing or composition to those ascribed to Boticelli, which we know, at least, were designed by him; and as Baldini is expressly said to have worked from the designs of Boticelli, it will appear most probable that they belong to Finiguerra."

With respect to the invention of etching we must speak with less certainty. Albert-durer has left us one of the most early specimens of this art, in his piece known by the name of the Cannon, dated 1518: he has also bequeathed us another etching, dated 1524, representing Moses receiving the Tables of the Law. Parmegiano soon after practised it in Italy. In his works we discover the hand of a great man, labouring under innumerable difficulties, and working, as it were, upon a system of his own invention. We cannot help admiring his efforts, though he failed in producing the forms he wished to express. On examining the mechanical part of the execution, we may plainly perceive that the subject was novel to him, and that he had had no instructions or directions: he died in the year 1540.

That species of engraving which unites etching with the use of the graver, was, no doubt, adopted very early; that is, immediately upon the invention of etching: but G. Audran was the first who carried it to perfection.

The Italians, however, have not entirely secluded themselves from their share of honour in this branch of the arts. Agostino Demusis, commonly called *Augustine of Venice*, a pupil of Marc Antonio, used it in several of his earliest works, but confined it to the flesh, as appears in the print of an old man seated on a bank, with a cottage in the back ground, without any date. Augustine flourished from 1509 to 1536. We have also another print of this nature, by Giulio Campagnola, of a single figure, standing, and looking upwards, with a cup in his hand, and said to be engraved about the year 1516; the background is executed with round dots, made, apparently with a dry point; the figure is outlined with a stroke deeply engraved, and finished with dots, in a manner greatly resembling those prints which De Marteau engraved at Paris, in imitation of red chalk. The hair and beard are expressed by strokes. Stephen De Laulne, a native of Germany, followed the steps of Campagnola; executing many of his slight works in dots only. This kind of engraving was greatly improved about the middle of the seventeenth century, by John Boulanger, a French artist, and his cotemporary, Nicholas Plattenberg; but it is only within the last fifty or sixty years that it has been deemed an object worthy of general imitation. John Lutma, as before observed, executed his works, of this kind, with a hammer, and a small punch or chissel, and was the first who practised that mode, but which was afterwards, for some time, generally followed.

Engraving in mezzotinto is a later discovery than the foregoing; invented by Prince Rupert, about the middle of the seventeenth century, though it is generally asserted that he had the secret from another.

Engraving in aqua tinta is the most modern of the whole, and does great honour to the improved state of the arts in the present age, whether we consider it with regard to the beauty of its effect, or the ingenuity displayed in the execution of the work throughout. It partakes of the excellence of most modern discoveries, and arrived at a considerable state of perfection, even while in the hands of the inventors.

Engraving in strokes, or hatches, with the tool, is, undoubtedly, the most ancient kind of engraving, and is still retained for many very useful and valuable purposes. For though etching be performed with a great deal more ease and expedition, and has several other advantages attending it; yet the strokes, or lines, are, by no means, so regular and exact as those wrought by the graver: for this reason, where great precision is required, engraving with the tool is preferred; as, in the execution of portraits, where the most minute parts must be expressed according to the original subject, without the least deviation, or varying the effect, either by that masterly negligence and simplicity in some parts, or those bold sallies of the imagination and hand in other parts, which give such spirit and force to historical painting.

Implements used in the Art.

The implements usually employed in the art of engraving on copper are few and simple; they consist of various formed gravers, a scraper, a burnisher, an oil stone, a sand bag, an oil rubber, and some good charcoal. There are, however, other instruments which we shall presently more fully examine, some of which have raised the mechanical execution of the art to a pitch of excellence superior to any thing previously known.

Gravers are small bars of steel, of a square or lozenge form, and with the short handle into which they are fitted, are about five inches long. One of the angles of the bar is always on the under side of the instrument, and the point is formed by bevelling the end from the uppermost angle. The square form is used for broad strokes, and the lozenge for fine ones. The upper end of the handle is a kind of knob, with the under side of it cut off, in order that the instrument may be used with the steel nearly in a horizontal position. The goodness of the steel, as well as its temper, is of consequence; gravers are generally over hard when first bought; but they should not be softened too hastily, as after a little grinding and whetting, they will be frequently found to answer perfectly, although in the first trial they were found defective. We may, however, remark, that if a graver will not make a mark upon common window glass, it is too soft. Towards the extremity, the graver should bend upwards a little, in order that the point may be more readily prevented from digging into the copper. The bevelled part, and the two sides which form the edge, should be rubbed upon the oil-stone in such a manner as to be quite flat. To take off any bur which may be occasioned by the whetting, the point is usually struck into a piece of box, or any other close

grained wood; and its sharpness is tried upon the nail; if it will cut the nail without leaving any jagged edge, it is fit for use.*

The dry-point or needle consists of steel wire, with a small cylindrical handle, or it may be of a sufficient length and thickness to be held without a handle. It should be tempered like a graver, and have a fine conical point; and should be entirely free from any angular edge, otherwise it cannot be drawn upon the copper in every direction, without sometimes producing a roughness which ought not to occur. The art of whetting it perfectly, though apparently a simple operation, is not acquired without considerable practice. The dry-point, when the bur which it raises is scraped off, leaves a softer and more delicate stroke than can be effected by any other means.

The scraper and burnisher are frequently made in the same piece, one at each extremity of a piece of steel, which is about seven inches long. The scraper has nearly the form of a triangular pyramid with the point cut off. It is used to remove the bur occasioned by the dry-point, and on similar occasions: any of its edges are used in this way. The burnisher is a cone, except that it is a little convex on the side; it is used to rub out scratches which appear on the plate, and to lessen the force of a line which has been cut too deep. The scraper and burnisher are each about an inch or rather more in length, and the middle part of the steel is the handle by which they are held.

The oil-stone should be a piece of the best Turkey hone, used with olive oil.

The cushion is a bag of leather filled with sand. It should be about three inches thick, and always less than the plate to be engraved. The plate is allowed to rest upon it, and may, by means of it, be more readily turned round, or in any direction, to produce the curves required.

Parallel rulers and compasses will be required as in drawing; the

* Great care is required to whet the graver nicely, particularly the belly of it, the two angles of which are to be held next the plate flat upon the stone, and the artist must rub them steadily till the belly rises gradually above the plate, so that when you lay the graver flat upon it you may just perceive the light under the point, otherwise it will dig into the copper, and then it will be impossible to keep a point, or execute the work with freedom. In order to this, keep your right arm close to your side, and place the fore-finger of your left hand upon that part of the graver which lies uppermost on the stone. When this is done, in order to whet the face, place the flat part of the handle in the hollow of your hand, with the belly of the graver upwards, upon a moderate slope, and rub the extremity, or face, upon the stone, till it has an exceedingly sharp point, which may be tried upon the thumb-nail.

When the graver is too hard, as is usually the case, when first used, and may be known by the frequent breaking of the point, the method of tempering it is as follows: heat a poker red hot, and hold the graver upon it, within half an inch of the point, till the steel changes to a light straw-colour, then put the point into oil to cool: or, hold the graver close to the flame of a candle till it be of the same colour, and cool it in the tallow, but be careful, either way, not to hold it too long, for then it will be too soft; and in this case the point, which will then turn blue, must be hardened again. Be not too hasty in tempering, for sometimes a little whetting will bring it to a good condition when it is but a little too hard.

former should have a brass edge; and the latter should be entirely made of steel, with a spring instead of a joint at the head, and with a screw to regulate the opening of the limbs.

(TO BE CONTINUED.)

ON TANNING, LEATHER DRESSING, DYING, &c.

(Continued from p. 299.)

Saffian or Maroquin Leather.

A valuable *Saffian*, or dyed *Maroquin* leather, almost equal to that of Turkey, is prepared largely at Astracan, and other parts of Asiatic Russia. Only bucks' and goats' skins are used for this purpose. The favourite colours are red and yellow. The general method of preparing the pelt is the same as in this country for the dyed Morocco leather; that is, by lime, dogs'-dung, and bran. Honey is also used after the branning. The honey is dissolved in warm water, and some of this liquor is poured on each skin, spread out on wooden trays, till it has imbibed the whole of the honey; after which it is suffered to ferment, for about three days, and then salted in a strong brine, and hung up to dry. The skin is then ready to receive the dye, which, for red, is made with cochineal, and the *salsola ericoides*, an alkaline plant, growing plentifully on the Tartarian salt desarts, and the colour is finished with alum. When dyed, the skins are tanned with sumach. To the very finest reds, a quantity of sorrel is used with the cochineal bath; and the subsequent tanning is given with galls, instead of sumach, which renders the colour as durable as the leather itself. The roughness always observed on the surface of the skin, is given by a heavy kind of iron rake, with blunt points. The yellow *saffians*, are dyed with the berries of a species of *rhamnus*, (the Avignon-berry would answer the same purpose, and is used in other countries,) or with the flowers of the wild chamomile.

The singular and valuable leather, called *shagreen*, is a manufacture almost peculiar to Astracan, where it is prepared by the Tartars and Armenians. For making shagreen, only horses, or asses, hides are taken, and it is only a small part from the crupper along the back that can be used for this purpose. This is cut off immediately above the tail, in a semicircular form, about 34 inches upon the crupper, and 28 along the back. These pieces are first soaked in water, till the hair is loose, and is scraped off; and the skin again soaked, is scraped or shaved so thin as not to exceed a wetted hog's-bladder in thickness, and till all the extraneous matter is got off, and only a clean membranous pelt remains. The piece is then stretched tight on a frame, and kept occasionally wetted, that no part might shrink unequally. The frames are then laid on a floor, with the flesh sides of the skins undermost, and the grain sides are strewed over with the smooth black hard seeds of the *alabuta* or *goose-foot*, (*chenopodium album*,) and a felt is then laid upon them, and the seeds trodden in deeply, into the soft moist skin. The use of this is, to give the peculiar mottled or roughened surface, for which shagreen is distin-

guished. The frames, with the seeds still sticking to the skins, are then dried slowly in the shade, till the seeds will shake off without any violence; and the skin is left a hard horny substance, with the grain side deeply indented. It is then laid on a solid block, covered with wool, and strongly rasped with two or three iron instruments, (the particular forms of which need not be here described,) till the whole of the grain side is shaved, so that the impressions of the seeds are very slight and uniform. The skins are then softened, first with water, and then with a warm alkaline lye, and are heaped, warm and wet, on each other; by which means, *the parts indented by the impression, regain much of their elasticity; and having lost none of their substance by paring, rise up fully to the level of the shaved places*, and thus form *the prominent grains*, or the granular texture, peculiar to the shagreen. The skin is then salted and dyed.

The beautiful green dye is given, by soaking the inner or flesh side of the skin, with a saturated solution of sal-ammoniac, strewing it over with copper filings, rolling it up with the flesh side inwards, and pressing each skin with a considerable weight, for about twenty-four hours, in which time, the sal-ammoniac dissolves enough of the copper to penetrate the skin with an agreeable sea-green colour. This is repeated a second time, to give the colour more body.

Blue shagreen is dyed with indigo, dissolved in an impure soda, by means of lime and honey. *Black shagreen* is dyed with galls and vitriol. The skins are finished with oil, or suet.

On various Preparations of Carmine.

(Continued from p. 302.)

CHINESE CARMINE.

Twenty ounces of very finely-powdered cochineal are boiled with a pailful of river water, contained in a proper vessel; to which sixty grains of Roman alum are added. After seven minutes' ebullition, the boiler is removed from the fire, and the liquor put into another vessel, by means of a siphon: it may also be passed through fine linen: This liquor is to be preserved for use. A solution of tin is previously prepared, in the following manner. Ten ounces and a half of common salt (muriate of soda) are dissolved in a pound of aqua-fortis (nitric acid:) to this solution, when cold, four ounces of Malacca-tin filings are added, by degrees:—a fresh quantity of tin must not be put in till the former is dissolved. This solution is added, drop by drop, to the heated cochineal liquid; and the carmine precipitates. When the carmine is deposited, the liquid is decanted; and the carmine allowed to dry in the shade, in china or Delft-ware vessels.

THE GERMAN METHOD OF PREPARING CARMINE.

Six pints of river water are boiled in a copper vessel: two ounces of powdered cochineal are then thrown into it, and well stirred. After six minutes' boiling, sixty grains of powdered alum are thrown

in, and the whole suffered to boil for three minutes. The vessel is then removed from the fire; and the liquor drawn off with a siphon, and filtered through a lawn sieve. The liquor is then placed in many china or Delft-ware vessels, and allowed to remain at rest for three days; when it is decanted, and the deposits dried in the shade. After three more days the liquor is again to be decanted; when it will have formed carmine of an inferior quality.

ALYON'S PROCESS.

Two pailsful and a half of river water being boiled in a copper vessel, a pound of ground cochineal is put into it by degrees, and the liquor is well stirred with a brush. After having boiled about half an hour, a weak alkaline ley is added, prepared with five drachms of soda, dissolved in a pint of water: this is poured into the decoction of cochineal; and, after half an hour's boiling, the vessel is removed from the fire, and set, in an inclined position upon a table. Six drachms of alum are then added, and well stirred into it; and the whole is afterwards left at rest for twenty-five minutes. The liquor, which is then become of a very fine scarlet colour, is to be decanted into another vessel; and the whites of two eggs, previously beaten up with half a pound of water, are added: the whole is then stirred up with the brush; and the vessel replaced upon the fire, and made to boil. The whites of eggs coagulate, and precipitate with the colouring substance, which forms the carmine. The boiler is then removed from the fire, and left at rest for twenty-five or thirty minutes, in order that the carmine may entirely deposit itself. The liquor is decanted; and the deposit placed upon fine linen, that it may drain. The carmine is afterwards removed with silver or ivory spoons, and dried upon plates which are covered with white paper. A pound of cochineal, by this process, affords an ounce of carmine.

It is essential that *soft water only* be employed.

We see, by two of these recipes, that alum is not, as many authors have advanced, an indispensable material, in the preparation of carmine: in one instance, it is replaced by the acid oxalate of potash; in another, by the hydrochlorate of tin: and the experiments of MM. Pelletier and Caventou prove that these salts, as well as the alum, serve, both to heighten the colour, and to assist in its precipitation, by the action of their excess of acid on the animal matter contained in the cochineal.

Carmine is very much used in miniature-painting: and a great quantity of it is also employed in the manufacture of artificial flowers. The confectioners and apothecaries make use of it, to colour various preparations; and it gives a beautiful tint, when mixed with any substances which they wish to colour. When it is used as a liquid colour, it is dissolved in the volatile alkali: the excess of alkali is dissipated by spontaneous evaporation; and, when the solution is become inodorous, it is fit for use.

MM. Pelletier and Caventou have given the name of Carmine to the pure colouring-matter contained in the cochineal, which is the basis of the carmine. These chemists have succeeded in separating it, by first macerating the cochineal in ether, in order to free it from

a greasy substance which it contains, and then repeatedly treating the cochineal with boiling alcohol. At each decoction, it deposits, on cooling, a granulated matter, of a beautiful red colour; and, on leaving the solutions to a spontaneous evaporation, the deposit continues to form, and then assumes a crystalline appearance. In this state, the colouring-matter of the cochineal is nearly pure; nevertheless, it still retains a little of the greasy substance; to divest it of which, entirely, MM. Pelletier and Caventou direct it to be re-dissolved in alcohol at 40°, and then to add to it an equal part of ether. This mixture is at first very thick, but afterwards becomes clear; and, in a few days, the sides of the vessel are found to be covered with an incrustation of a brilliant reddish-purple colour, which is *pure carmine*. This has been characterized by the following properties: its colour is a vivid purple; it has a crystallized appearance; is perfectly unalterable in the air; heat easily decomposes it, and without producing any azote; it is very soluble in water; and neither crystallizes by evaporation or cooling; it is insoluble in ether; soluble in boiling alcohol, &c.

Description of a Process for making Damasked Steel. By M. Breant.*

It appeared from M. Breant's former experiments, published in the "Bulletin de la Societé d'Encouragement," for 1821, that the watered or wavy appearance on the eastern damasked steel is not mechanically produced, but the result of a particular composition, and he has at length ascertained that it is owing to an increased quantity of carbon incorporated with the steel beyond the proportion contained in the common sorts. According to this chemist, the effect depends on two states of combination in which the carbon exists in the steel, and numerous experiments have enabled him to give the rules for several processes for the manufacture of different kinds of cast steel.

"The watered (*moirée*) surface of the oriental sabres has led to the supposition that they are made from what is called *stuff* (*etofe*,) that is, a bundle of steel bars, or wires, forged and welded together, and twisted in different directions.

"A long series of experiments has taught me that the substance of the oriental damask is a fused steel, more loaded with carbon than our European steels, and in which, by means of a proper management in the cooling, a crystallization of two distinct compounds of iron and carbon is effected.

"This separation is the essential condition; for if the fused matter be suddenly cooled, as is the case when cast into small ingots, no appearance of damask is perceptible; it is only to be discovered by using a magnifying lens.

"Iron and carbon form at least three distinct compounds; steel,

* From the *Annales des Mines*.

which is at one of the extremities of the series, contains but a very small proportion (1-100th) of carbon; plumbago, on the contrary, contains from 12 to 15 times more carbon than iron. Black and white cast iron hold the middle place."

As bodies combine chemically only in definite proportions, if in making steel there be a deficiency of carbon, a portion of the iron will remain merely in a state of mixture with the steel that is formed, the quantity of the latter depending on the quantity of combined carbon: and on cooling the mass slowly, the more fusible particles of steel will have a tendency to unite together, and separate from the iron. This alloy, therefore, will show a damasked surface, but it will be white, ill defined, and the metal being mixed with iron will not be capable of much hardness.

The exact proportion of carbon requisite to convert all the iron into steel will give a homogeneous mass; and consequently no separation of distinct compounds can take place on cooling. "But, if the carbon be in slight excess, the whole of the iron will first be converted into steel; then the free carbon which remains in the crucible will combine in a new proportion with a part of the fused steel already formed, and there will thus be two distinct compounds, pure steel, and carburetted or cast steel. These two compounds, at first indiscriminately mingled together, will tend to separate as soon as the liquid matter is at rest, and crystallization will ensue, during which the molecules of the two compounds will arrange themselves according to their respective affinities and weights.

"If we dip a blade, made of steel thus prepared, in acidulated water, a very evident damask will be developed, in which the portions of pure steel will be black, and those of the carburetted will remain white, because the acidulated water does not so readily lay bare the carbon of the carburetted steel as of the pure.

"It is, therefore, to the irregular division of the carbon by the metal, and the formation of two distinct compounds, that the production of the damasked surface is to be attributed, and it is obvious, that the more gradually the mass is cooled, the larger will be the veins of the damask. It is, perhaps, for this reason, that we should avoid fusing the substance in too great a mass, or at least that some limit should be observed in the process; in support of which opinion I may quote Tavernier, who has given in his "Voyage en Perse" some information as to the size of the balls of steel, which, in his day, were used in making the damasked blades.

"The steel capable of being damasked, comes, says he, from the kingdom of Golconda; it occurs in commerce in masses of the size of a halfpenny loaf; they are cut in two to see if they be of good quality, and each half makes one sword blade.

"From this account it is evident, that this Golconda steel was in buttons like *wootz*, and that each button could not have weighed more than five or six pounds.

"Tavernier adds, that, if this steel were tempered by the European processes, it would be as brittle as glass. Hence, as Reaumur observed, it must be very difficult to forge.

"That Philosopher having received some specimens of Indian steel from Cairo, found no one in Paris who could forge it; whereupon he laid the blame on our workmen; since the inhabitants of the east know how to work that kind of steel. I will explain, presently, the proper method of proceeding to ensure success.

"As carbon has the chief influence, not only in producing the damask on steel, but also on its intrinsic qualities, I fear that Messrs. Stodart and Faraday were led into error in their experiments (as I, for a long time, was myself,) and attributed effects to metallic alloys which were owing more particularly to an increased proportion of carbon.

"I am very far from disputing the existence of metallic alloys in the oriental sabres, although, in the few fragments which I have had an opportunity of examining, I have not found either silver, gold, palladium, or rhodium; I think it very probable, however, that different combinations may have been attempted. A people who knew how to harden copper by alloying it with other metals, are very likely, from analogy, to have tried the same process with iron.

"This view of the subject led me to form various metallic alloys, some of which gave satisfactory results. One of the sword blades, which I presented to the Exhibition, contains one-half per cent. of platina, and a larger proportion of carbon than common steel; its damask is owing particularly to the latter. Excellent razors have been made with this alloy.

"At all events, these alloys should not be tried till we have fully ascertained the effects of pure carbon, and we ought to begin by combinations in very small proportions. The addition of a metal makes the steel more brittle; however, I have obtained ductile alloys, in raising the quantity of gold and platina, as high as 4 per cent., and that of copper and zinc to 2.

"As to zinc, certain precautions are necessary in forming alloys with that metal; it occasions violent detonations, wherefore it must be added to the fused metals in very small portions at a time. In forging steel alloyed with zinc, part of the metal is volatilized and dissipated.

"Manganese unites readily with steel, and the alloy forges easily; but it is very brittle when cold: I have made gravers with this alloy which cut iron without having been tempered: the damask of this mixture is very black and well defined.

"Plumbago appeared in some instances to soften steel which had been rendered too brittle by an excess of carbon; at least I have obtained excellent results with 100 parts of steel, 1 of lamp-black, and 1 of plumbago.

"But a very remarkable experiment, from the advantage that may result from it in working on a large scale, is one which showed that 100 parts of soft iron and 2 of lamp-black fuse as readily as common steel. Probably the whole of the carbon does not combine. Some of our best blades are produced from this combination. It has the disadvantage of contracting very much on cooling, and the buttons generally have cavities which make them very difficult to forge; but

if, instead of damasked, we only want to make common steel, the contraction on cooling may be prevented by casting this compound in an ingot mould.

"This experiment teaches us that the previous cementation of the iron is not necessary in order to obtain very good steel. It may be treated at once with lamp-black, which will very much lessen the expense of the manufacture.

"One hundred parts of very gray cast iron filings, and 100 parts of the same filings previously oxidated, gave a steel of a fine damask, and calculated for sword blades, &c. It is remarkable for its elasticity, an important quality in which the Indian steel is deficient. I have always operated on three or four pounds at a time. The larger the proportion of the oxidated ingredient, the tougher (*nerveux*) is the steel. The oxygen combining with the metals of the earths, and part of the carbon, it is obvious that the more oxide there is, the more ductile will be the result; but it will also be softer. The blackest cast iron answers best. I am convinced that with that substance we may make cast steel in reverberatory furnaces on a very large scale, by adopting a process analogous to that used in refining bell metal, namely, by adding to the fused metal a portion of the same metal oxidated; or, still better, native oxide of iron.

"It seems to me to be equally practicable to convert the whole of the product of the Catalonian forges (*forges à la Catalane*) into cast steel, by altering the construction of the furnaces so as completely to fuse the metal. I think, if I had the direction of one of those forges, I could find means to manufacture steel of the most desirable quality with great saving of expense.

"I have always been careful to stir the fused metal thoroughly before I suffered it to cool; this is indispensable in making metallic alloys, for without it the damask is not homogeneous.

"It was after I had attempted to combine steel with aluminum and silicium, that I observed the influence of carbon in producing the damask: from that time I always used the carbon of lamp-black.

"If some earths be found on analyzing my cast steel, they must probably be attributed to the cast iron employed, or to the iron, the plumbago, or the crucibles.

"The more carbon a steel contains, the more difficult it is to forge. The greater number of those that I have prepared can be tilted at only very limited temperatures. At a white heat they crumble under the hammer; at a cherry-red they become hard and brittle, and this quality increases in proportion as the temperature diminishes; so that when once it has fallen below cherry-red, if we endeavour to cut it with the graver, or the file, we find it much harder and more brittle than after it is completely cold.

"It is evident that the Indian steel, which most of our workmen are unable to forge, is similarly circumstanced; and if the Indians work it without difficulty, it is because they know the limits of temperature within which it is manageable.

"I am convinced from experience that the orbicular veins, which the workmen call brambles (*ronce*,) and which are seen on the beau-

tiful Indian blades, are the consequence of the way in which they are forged. If steel be drawn out lengthwise, the veins will be longitudinal; if it be equally extended in all directions, the damask will have a crystalline appearance; if it be rendered wavy in both directions, it will be shaded like the eastern damask. But few trials are necessary to produce any sort of watering that may be desired.

"The best process for developing the damask, so that the steel may become black or bluish, without losing its polish, is, in my opinion, that which is employed in the East. It is described, by M. le Vicompte Héricart de Thury, in a report inserted in the 'Bulletin de la Société d'Encouragement,' No. 220, for December, 1821, twentieth year, p. 361."

On the Use of Animal Charcoal, as a Flux.

TO THE EDITORS OF THE ANNALS OF PHILOSOPHY.

Gentlemen—The great power of wood charcoal as a flux for minerals and metallic ores has been long known, and extensively taken advantage of in the arts and operations of chemistry, but I am not aware that any application of *animal* charcoal to the same purposes has hitherto been attempted. The following facts, however, it is thought, furnish sufficient grounds for believing that the latter might prove an advantageous substitute for the former, in those cases where its comparative expense would admit of its employment; and they may, therefore, perhaps, obtain a corner in the *Annals of Philosophy*, if not occupied with more important matter.

Being in the habit of using animal charcoal as a dentrifice, I nearly filled a brass crucible of moderate size, and about four-tenths of an inch in thickness, with ivory-black, for the purpose of purifying it by re-ignition. The crucible was closed with a cast iron cover, which had a small perforation in it as a vent for the gas which was extricated; and in this state was set in the fire-place of an air furnace, which was commonly employed for heating alkaline lixivia. The fire was not very large, though thoroughly inflamed, and the grate door was left wide open. The crucible soon acquired a red heat (to which it had, prior to this, been frequently exposed,) and the gas burned steadily at the aperture in the cover. Being obliged to leave it at this period, on my return in about ten minutes, I was a little surprised to find the iron cover of the crucible lying by itself, and no vestige of the latter apparent in the fire-place. On examining the ash-pit, several rugged pieces of brass were found, and two large masses of cinders, firmly compacted together by an upper coating of oxidized brass. In one of these a large stick of the metal was imbedded, which broke with a rough coppery appearance, but on filing immediately displayed its brassy nature.

As the heat by which this was affected appeared to me much inferior to that which brass generally requires for its fusion, I exposed some brass wire, about one-tenth of an inch in diameter, by itself in the same fire, and closed the door. After remaining there nearly half

an hour, it was taken out broken into two parts. It was become oxidized, and, as it were, wormeaten on its surface, and was rendered very brittle in its fracture, but it had not the least appearance of any loss by fusion.

Endeavouring again to effect my purpose with the ivory-black, I exposed some of it in a *cast iron* crucible, in the same fire-place, and the door open as before. This crucible was only three-tenths of an inch thick, and had occasionally been exposed for short periods to the greatest heat of this fire-place; not expecting, therefore, that it would receive any injury in the present instance, I left it unnoticed for about 20 minutes, by which time the ivory-black had ceased to emit any more gas. It was then taken out, but unfortunately not in the condition in which it was introduced. Nearly half the circumference of the crucible for one and a half inch upwards, and a large part of its bottom, had run into a complete slag upon the opposite side, which happened to have fallen lowest in the fire, and the ivory-black was almost consumed, from the access which the air thus acquired to the inside of the crucible. The cover and upper parts of it had suffered no injury.

From the great heat which brass and particularly cast-iron require for their fusion, and the low degree of it employed in these cases, little doubt can be entertained of the superior agency of animal charcoal as a flux. Both the crucibles it must also be noticed had been formerly used for the very purpose of procuring charcoal from wood in a common grate, when it is conceived the heat was little inferior to that in the present instance, and the chances of their fusion then otherwise equal. It might, therefore, be worth the trouble for those whom it may concern, to make one or two comparative experiments on this subject, with greater accuracy than the preceding, in order to determine it decisively. F.

Is it not probable that in the experiments above detailed, the metals were converted into phosphurets by the decomposition of the phosphoric acid? and if so, the increased fusibility would probably be derived from this circumstance.—*Editor of Annals of Philosophy.*

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*On the Manufacture of Ceruse, Krems-White, or White-lead; and, particularly, of the celebrated Ceruse of France.**

Ceruse, or *White-lead*, is the *sub-carbonate of lead* of the Chemists.† This preparation is chiefly used in painting wood, or other articles, white. As it easily mixes with oil, and preserves its colour well, it is spread with facility by the brush, and affords a good body of colour, on whatever substance it is applied. It is either employed alone, as a colouring matter, or mixed with other colours, as well to brighten

* From the *Dictionnaire Technologique.*

† The common *ceruse* is frequently adulterated by the admixture of foreign matters; such as lime, sulphate of barytes, &c.; but *pure ceruse* will not admit of any of these mixtures, without detection.

them as to give them body. Ceruse is manufactured in various ways, in different countries. England and Holland, for a long time furnished commerce with this article; but establishments for the manufacture of it have been singularly multiplied within a few years; and there now exist a great number of them. in Germany, in the Netherlands, and in France. Marcel de Serres has given us an exact description of the process followed in Germany; and we cannot do better, than to copy it literally, for the information of our readers. We shall afterwards point out the different modifications of the process, as used in other countries, particularly the new process adopted in France; and terminate the article by giving some general observations on Ceruse.

Krems-white has been so named, from the place where the first preparations of this colour were made: but, for some years past, the manufactories, which formerly existed there, have ceased working; and the finest manufactory of this article is situated at Klagenfurt, in Carinthia. This manufactory belongs to Baron Herbert: it is much more considerable than that at Feldmuhl, which belongs to Baron Leykam; or even than that at Vienna.

The town of *Krems* being much less known to the chemists and mineralogists than *Kremnitz* in Lower Hungary, they have often, by mistake, termed this preparation *Kremnitz-white*, although it has never been manufactured at all in the latter place.

In order to give an exact idea of the method used by the Germans in preparing *Krems-white*, we will describe the various operations used in their processes.

First Operation.

The lead used in all the manufactories of *Krems-white* is brought from Bleiberg, near Willach, in Carinthia. This lead is very pure, and does not apear to contain any oxide of iron,—a quality most essential to the beauty of the white. It is easy to judge of the advantages which the manufacture of Klagenfurt possesses over all the others, in having this pure lead so near at hand. The lead is melted in the common melting-pots; and then formed into leaves of various thicknesses, according to the manufactories. In order to make these leaves, the fused lead is poured upon a plate of cast-iron, with raised edges, placed above the pot; and as soon as the surface of the metal begins to consolidate, the iron plate is a little inclined: the lead which remains fluid then falls back into the melting-pot; and that which has set, or becomes solid, remains, and is raised up like a sheet of paper. The workmen, being careful to cool the plate from time to time, with water, may easily cast many quintals of lead in a day. The leaves of lead vary both in size and thickness. In some manufactories, they are half-a-line* thick; and in others, scarcely a quarter. In certain manufactories, one of these leaves will entirely fill the box used in

* A line is the twelfth part of a French inch, and rather exceeds the tenth part of an English inch; eleven English tenths of inches being nearly equal to the French inch

the succeeding process; whilst, in others, four will be required for that purpose. It is essential that the surfaces of the leaves should not be smooth; for it is evident, that a rough surface is easily attacked by acid vapours, whilst an even one presents fewer points of contact.

Second Operation.

The formation of the leaves being thus accomplished, they must then be so disposed as to be easily attacked by the acids: for this purpose, they bend the leaves, and suspend them over pieces of square wood, the width of the boxes in which they are to be placed: these leaves, thus suspended by the middle, resemble the leaves of a book; and are placed, with the pieces of wood supporting them, in wooden boxes. The size of these boxes is nearly the same in all the manufactories: their length is about four and a half or five feet; their width from a foot to a foot and two inches; and their depth from nine to eleven inches. These boxes are made very strong: they are always careful to secure them by mortises; and to observe that the nails, with which they are fastened, do not project through the sides of the wood. They never totally close these boxes, with the leaves of lead in them; but cover their bottoms with a coating of pitch, about an inch thick. These boxes are, however, luted with paper, in those manufactories where the stoves are heated by smoke; for we well know how hurtful the vapours of sulphuretted and phosphuretted hydrogen gas are to white colours, and how quickly they attack the oxides of lead. In Carinthia, they formerly used, as well as in Holland, to form the leaves of lead into coils, and place them, thus coiled up, in the boxes: but this method does not appear to be advantageous; because it is evident that these coils present less surface to the action of the acid vapours, and they often fall into the liquid at the bottom of the boxes; which ought to be carefully avoided, because the carbonate of lead then formed is never white. The leaves, thus bent, and suspended on the pieces of wood, are placed in the boxes, so as to be at the distance of about two and a half inches from the bottom. They are very careful that the leaves of lead do not touch each other, nor the wood of the boxes: for if they were to touch, the vapours could not so easily corrode them; and if they touched the wood, the carbonate of lead would be discoloured, and its whiteness injured. Previous to placing the leaves of lead in the boxes, they put in a mixture; which is not, however, the same in all the various manufactories: the proportions of this mixture being, in some, equal parts of vinegar and the lees of wine; whilst, in others, they use a mixture of twenty pounds of lees of wine, eight pounds and a half of vinegar, and one pound of carbonate of potash. It is evident, that, in those manufactories where carbonate of potash is not used, nor smoke employed to heat the boxes, it is not requisite to lute them; and that in those, on the contrary, where carbonate of potash and smoke are used, there is the greatest necessity for so doing: so that, in different manufactories, things which are the most opposite are recommended, and for very obvious reasons.

Third Operation.

The mixture being poured into the boxes, and the leaves of lead deposited in them, they place the boxes in a particular kind of stove; in which, by means of heat, the vapour of the mixture which was put into the boxes, in rising, corrodes the leaves of lead, and forms a carbonate. The stove is usually heated by two furnaces; seldom contains more than ninety boxes; and has only one opening, which is used as a door. Although it is not very important to give the exact size of these stoves, nevertheless, as faithful narrators, we should mention, that the one measured was nine feet high, four toises wide,* and five toises long.

The heat must never be raised above thirty degrees,† and is generally continued about a fortnight; at the end of which time the operation is terminated. If the heat be too strong, and the vapours too thick, a great part of the carbonic acid escapes: and the lead being less attacked by these vapours, the produce of carbonate of lead is much less considerable.

When the operation has been well conducted, an equal quantity of carbonate of lead, by weight, will be obtained, as of the lead which had been employed: thus, if three hundred pounds of lead be put into the boxes, the same quantity of carbonate of lead will be formed; as, when the crust of carbonate of lead is completely collected, a small quantity of lead will be found, which must be fused afresh, to form new leaves. The mixture, which is put into the boxes to form the carbonate of lead, will only serve once: and when, as in many manufactories, potash enters into the mixture, the residuum is sold to the hatters.

Fourth Operation.

When it is presumed that the preceding operation is terminated, and that the leaves of lead have been properly corroded, they are removed from the boxes: they will then have become a quarter of an inch in thickness, or even more; whereas, in the first instance, they did not exceed the thickness of a quarter of a line. Rather large-sized crystals of acetate of lead are frequently observed on the edges of these leaves.

When the leaves of lead are removed from the boxes, they must be well beaten, in order that the crust of carbonate of lead, which is formed on their surfaces, may be removed. The carbonate of lead, thus obtained, is then put into large vats; where it is purified, by means of washing-over. Whenever it happens that there are any small pieces of lead found remaining in the boxes, they are washed in water in order to dissolve and separate the acetate of lead which may adhere to them.

The manner of washing over the carbonate of lead is very simple, and resembles a great number of other processes of this kind. For washing over the carbonate of lead, they use a large wooden vat, generally of a square form, and divided into seven or nine compart-

* The toise is equal to 76,734 English inches.

† Or 86° of Fahrenheit.

ments, which are all equal in size; but the partitions between them vary in height; so that, when the first or highest compartment is full, the water flows into the second, and so on. The water which flows into the first compartment passes successively into the others; and the workmen being careful to keep it always in motion, it successively deposits the ceruse which it carries along with it; the precipitates of white lead, which are found in the furthest compartments, being successively, the finest and lightest. When the white lead has been thus washed over, it is deposited in other large vats; where it receives a second washing, and in which it is kept constantly under water. It is necessary to observe, that when the carbonate of lead is washed with water, a white scum always rises, and floats on the surface; this appears to be a kind of acetate of lead. In order to precipitate the small quantity of carbonate of lead found in solution, a little potash is added, and the carbonate instantly precipitates. This phænomenon, however, merits a more accurate observation. The carbonate of lead, purified by the washings to which it has been subjected, and remaining in the vats, would always preserve the consistence of a liquid paste: but, for convenience in commerce, it is always removed from the vats with wooden spatulas, and placed upon the drying stages. When it comes in contact with the air, it very soon acquires the consistency of a soft paste; in which state it is put into moulds, in order that it may assume the form in which it is generally found in commerce.

All the carbonates of lead sold in commerce are nearly of the same quality; provided that no other substances are added to them; and, more particularly, if those which appear of the finest white, and are the most pure be not separated from them. The varieties of carbonates of lead, bearing different names, are thus regulated.

First quality.—The carbonate of lead found in the last, or lowest department, is the finest. When carefully prepared, this is designated, in Germany, by the name of *Kremserweiss*, or *Krems-white:* it is likewise known by the name of *silver-white.* It is used by the apothecaries, and artists, for the most delicate purposes. Sometimes, however, a carbonate of lead, which remains floating a considerable time, is still whiter. This *Krems-white*, of the first quality, is entirely pure; and it is never mixed with sulphate of barytes, like those of inferior qualities; so that it may be regarded as a pure carbonate of lead.

Second quality.—This second sort is formed by mixing equal parts of sulphate of barytes with carbonate of lead: it is known, in Germany, by the name of *Venerianerweiss*, *Venice-white.*

The sulphate of barytes used in Germany, in the manufactories of carbonate of lead, is generally brought from the Tyrol; because, perhaps, it does not contain oxide of iron; but sometimes they obtain it from Styria. The ferruginous oxide, which may be contained in sulphate of barytes, is very prejudicial to the beauty of the white colour, so much desired; and especially when the sulphate is calcined, which is done for the purpose of pulverizing it the more readily: and the calcination particularly discolours that from Styria, on account of the

oxide of iron which it contains; whilst that from the Tyrol still remains white. In some manufactories, however, where they have perceived this inconvenience, they now cease to calcine the sulphate of barytes.

Third quality.—This third sort is formed by mixing two parts of sulphate of barytes with one of carbonate of lead: it is known in Germany by the name of *Hollanderweiss, Dutch-white.*

These various kinds of white are generally made according to the proportions we have described: however, for the manufacture of a very cheap article, they mix seven parts of sulphate of barytes with one of carbonate of lead: this white, nevertheless, always bears the name of *Dutch-white*, but is rejected for delicate painting. It is convenient that white lead should sometimes be mixed with sulphate of barytes; and for this simple reason, that it gives it more opacity; a convenience, however, which can only exist in the painting of the less-delicate pictures: as in the most-delicate paintings, its transparency is rather an advantage than otherwise.

(TO BE CONTINUED.)

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*On extracting the Colouring Matter from the Carthamus.**

Carthamus, or Bastard Saffron, (*saframum, carthamus tinctorius,*) a plant of the *syngenesia polyg. æqualis* of Linn., the *flosculosi* of Tournefort, and the *cinarocephalæ* of Jussieu, is an annual; grows spontaneously in Egypt, of which it is a native; and is cultivated in India, and some parts of Europe, on account of its valuable properties for dying. It has a straight, firm, smooth, and whitish stem, two or three feet high; which is divided towards the top into many branches, furnished with leaves that are simple, entire, oval, pointed, and bordered with prickly teeth; each branch being terminated by a somewhat large flower, in which the scales of the calix are spinous, the florets hermaphrodite, and the corols, which have five segments, of a beautiful red-saffron colour.

The corol of the *saframum* is usually gathered as soon as the flower begins to open, because it loses its lustre when it is more fully blown. It must be dried in the shade, and preserved from any damp or moisture. It is the more valuable, in proportion to the brightness of its tint. When it has a dusky hue, it is a certain proof that it has either been gathered in a rainy season, or badly dried, and that its colouring matter is greatly deteriorated.

The corol, which is also called the flower of the carthamus, and commonly *safflower*, is very much used in dying. It contains two colouring matters; one of a reddish yellow, which is rejected as useless, because it produces only inferior shades; the other, which is of a beautiful red, serves to produce every shade, from the most delicate rose to the deepest cherry-red. The first easily dissolves in cold water; whilst the second, which is of a resinous quality, does not possess the same property. In order to separate the one from the

* From the *Dictionnaire Technologique.*

other, it is sufficient to wash the carthamus under a small jet or stream of water, which removes the yellow colouring matter. When the water becomes colourless, the washing may cease, and the carthamus be macerated in a weak solution of soda: the bath soon becomes coloured of a darkish yellow red. When it is thought that the maceration has been sufficiently prolonged, it is passed through a sieve or filter; then carded cotton is plunged into it, and a vegetable acid is added, until the alkali is completely saturated. Lemon-juice is generally preferred, because it renders the colour more vivid. The carbonic acid which is disengaged during the saturation produces a slight effervescence, which requires attention, lest the liquor should flow over the edges of the vessel: it must be continually stirred, and the acid be added by degrees. The colouring matter, which was only held in solution by the alkali, separates from the solution as the saturation is effected; but, instead of being deposited on the sides of the vessel, it fixes itself, in preference, on the cotton, with which it has an affinity. The first washing of the carthamus can never sufficiently clear it of the yellow-colouring matter; a portion of it is always found in the alkaline solution, and rather injures the tint of the cotton which has served to collect it; but this is removed with facility by further washings. When the cotton has been well washed, it is again treated with a fresh solution of carbonate of soda; and a bath is obtained, containing only the red-colouring matter, perfectly pure. When it is used for dying, the stuffs are plunged into it; and, as in the former case, a sufficient quantity of lemon-juice, or tartaric acid, is added. If it is wished to separate the colouring matter as it is employed in making bunches of artificial roses, the manipulation is exactly the same; with this difference only, that the vessel does not contain any cotton on which the colouring matter might fix, and it therefore deposits itself by degrees in very minute particles: the liquor is then decanted, the precipitate is washed, and distributed into several saucers; and assumes, on drying, a kind of greenish-coppery tint, affording, by reflected light, an appearance somewhat like that of cantharides.* The rose-coloured tint is developed as soon as water is added to it. This colouring matter, mixed with the chalk of Briancon† reduced to an impalpable powder, constitutes the *vegetable rouge* or paint. R.

On Artificial Stone Chimney-pieces. By Mr. Charles Wilson.

From the Transactions of the Society of Arts, &c.

Take two bushels of sharp drift-sand, and one bushel of sifted slaked quick-lime; mix them together with as little water as possible, and beat them well up together for half an hour every morning, for three or four successive days; but never wet them again after their first mixture.

* These saucers are sold in this country, in the colour shops; and are known by the name of *pink-saucers*.

† In England, steatite, or French chalk, reduced to fine powder, by means of Dutch rushes, is employed for this purpose.

To two gallons of water, contained in a proper vessel, add one pint of single size, made warm; a quarter of a pound of alum, in powder, is then to be dissolved in warm water, and mixed with the above liquor.

Take about a shovel full of the first composition, make a hole in the middle of it, and put therein three-quarters of a pint of the mixture of alum and size, to which add three or four pounds of coarse plaister of Paris; the whole is then to be well beaten and mixed together rather stiff; put this mixture into the wooden moulds of your intended chimney-pieces, the sides, ends, and tops of which moulds are to be made of moveable pieces; and they must be previously oiled with the following mixture:

Take one pint of the droppings of sweet-oil,* which costs about one shilling the pint; and add thereto one pint of clear lime-water, made by pouring boiling water on lumps of chalk-lime in a close vessel, till fully saturated: when the lime-water becomes clear, it is fit to be added to the oil, as above-mentioned; and on their being stirred together they will form a thick oily mixture, or emulsion proper to apply to the moulds. In forming the side or jamb of a chimney-piece, the mould is to be first half-filled with the sand, lime, and plaister composition; then two wires, wrapped round with a thin layer of hemp or tow, and which wires are nearly the length of the piece to be moulded, are to be placed in parallel lines lengthways, in the mixture or composition in the mould; and afterwards the mould is to be filled up with more of the composition; and if there be any superfluous quantity, it is to be struck off with a piece of flat board.

The lid or top part of the mould is then to be placed upon it, and the whole must be subjected to a strong pressure, either from weighted levers or a screw-press. The composition is to remain under this pressure for twenty or thirty minutes; the precise time necessary, may be known by examining a small specimen of the composition, reserved purposely to determine the time it requires to harden and set firm in.

The sides of the moulds are to be held together by iron clamps and wedges.

The wires above mentioned answer the double purpose of giving strength to the jambs, and of retaining the whole mass together, in case it should at any time be cracked by accident.

The chimney-pieces may be made either plain or fluted, according to the mould; and when moulded, they are finished off by rubbing them over with alum-water, and smoothing them with a trowel, and a little wet plaister of Paris.

A common plain chimney-piece of this composition, is sold at only seven shillings (*sterling;*) and a reeded one at twenty-eight shillings, completely fitted up.

* The droppings of sweet oil is an impure, or rancid olive oil, unfit for the table. Any other oil will answer the purpose.—Editor.

On a Wholesome Glaze, for Common Red Earthenware; and on an improved Common Earthenware. By Mr. J. Meigh, *of Shelton, Staffordshire.*

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

The common coarse red earthenware is made of brick clay, hence it is very porous: it is also baked at as low a heat as possible, partly in order to save the expense of fuel, and partly, being made of common clay, which varies considerably in its fusibility, it will not always bear a high firing, without losing its shape, and becoming unsaleable.

For the reasons above mentioned, it is necessary to employ a glaze, fusible, cheap, and capable of filling up the pores of the ware, so as to enable it to hold fluids in ordinary use, either as articles of food or of domestic employment. Litharge, and the common potter's lead-ore, are the articles usually employed; the one for the transparent, the other for the black opaque glaze. The objections, however, to a glaze, wholly or in part composed of lead, are, first, that it cracks when raised rapidly to the temperature of boiling water, on account of the different ratio of expansibility between the glaze and the clay, and then admits the liquor into the body of the ware: secondly, the glass of lead by itself, or even when mixed in small proportion with earthy substances, is very soluble in vinegar, in the acid juices of the common fruits, and in animal fat, when boiling. When such substances, therefore, are cooked in vessels of common red earthenware, a quantity of salt of lead is formed, which, mixing with the food, produces violent colics, and all the serious, and often fatal effects, that attend the internal administration of the salts of lead.

The discovery of a better and more wholesome glaze, sufficiently cheap to be applied to the common red ware, appeared to the Society to be an important desideratum; and, in their opinion, this is now effectually supplied, by the discovery about to be detailed.

The rock called red marl is usually in the form of beds, of a soft, coarse, slaty structure, and red colour, forming the chief part of the common soil, in many extensive districts in this island, to the N. and W. of a line running obliquely from Durham to Exeter. This marl is easily ground in water to an impalpable powder, which remains suspended for a considerable time in the fluid. A mixture of this kind is prepared; and the ware previously well dried, but not burnt, is immersed in it. The superficial pores of the clay are thus filled with fine particles of the marl; and a fit surface is prepared, on which to lay the glazing. Being again carefully dried, the ware is ready for the glaze, which is thus composed:

Take 1 part Cornish granite, consisting chiefly of felspar,
1 part glass,
1 part manganese;

the whole well ground together, and diffused in water, to the consistence of cream. Dip the ware in this mixture; and, when thoroughly dry, place it in the kiln, and fire it in the usual way. The result

will be a solid black glaze, very permanent, and not containing any ingredients noxious to health. If an opaque white glaze is required, omit the manganese.

Mr. Meigh has also employed common marl, and the red marl, as ingredients of the body of the ware, with excellent effect; without increasing its expense. He uses for this purpose,

4 parts of common marl,
1 part of red marl, and
1 part of brick clay.

Vessels made of the above mixture are in possession of the Society. The colour of the body is a reddish cream brown: it is harder, more compact, and less porous than the common red ware; and its general adoption, with the above-mentioned glaze, would contribute, in no inconsiderable degree, to the health of the lower classes, by whom alone the common red ware is used for vessels of cooking.

ENGLISH PATENTS.

To James Falconer Astlee, *for a method of condensing wood, and giving it a closeness of grain for resisting moisture, for the construction of furniture and other purposes.*

The timber is cut into planks with parallel surfaces: these planks are passed between polished iron or steel rollers, the pressure of which condenses the wood. The pressure thus applied, must at first be small, and afterwards gradually increased; otherwise the wood will be crushed or split. The best way of applying the principle is to place several pairs of rollers behind each other, the distance between each pair gradually and progressively diminishing. The sap, or moisture will thus be forced out of the pores of the wood, at the ends and sides of the plank, and it will thus be rendered stronger, heavier and harder, and less pervious to moisture than in its natural state. When used in furniture it is less liable to scratch, and does not shrink. Oak and Mahogany admit of much more compression than Fur and other slight woods; and Honduras (bay) Mahogany, may be rendered as hard and as heavy as the best Spanish. If one of the rollers is sufficiently bright, a finished polish will be left upon the surface.

This plan, it is said, will be particularly useful in ship carpentry, for making wooden bolts, trenails and dowels of a compact quality.

The Editor doubts the correctness of the principles upon which the foregoing patent is founded. Every workman in wood, knows that if any part of a plank is accidentally indented, and is afterwards planed over, this part will swell out by the action of moisture. The process mentioned in page 181 of this Journal, depends upon this circumstance; the same effect will be as certainly produced upon a large, as upon a small surface, a plank thus condensed, if partially wetted, will swell in such part, and if exposed entirely to moisture, will expand throughout the whole mass. If the surface is to be polished by means of the rollers, it must first be made perfectly smooth, as

any roughness left upon the grain, could not be removed by the aid of the rollers; but little advantage would result from such a polish, as there are very few purposes to which the plank could be applied, without working it after it had passed through the rollers. Trenails and dowels may probably be improved by the process, as they may drive more readily, and by their expansion afterwards, may hold more firmly, than when driven in the ordinary way.

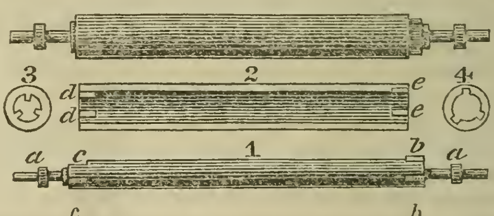
In the London Mechanics' Magazine, for 1823, it is mentioned that a piece of plank had been exhibited to the ship carpenters, and to others, which had been reduced, by compression, from six to three inches in thickness. The plank was of oak, the method employed is not stated, but it is averred that it was as hard as ebony, and shewed the growth of the timber as perfectly as the piece from which it had been cut.

Specification of the Patent granted to John Gunby, *of New Kent Road, in the county of Surrey, Sword and Gun Manufacturer, for a process by which a certain material is prepared, and rendered a suitable substitute for leather.* Dated February 28, 1824.

To all to whom these presents shall come, *&c. &c.* *Now know ye*, that in compliance with the said proviso, I, the said John Gunby, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in the following description thereof (that is to say:)—I take woollen or linen cloth, of any requisite thickness, or a mixture of linen and woollen, or linen, cotton, and woollen, or felt, &c. as all these fabrics are convenient for my purposes. For such articles as require a pliable quality for the manufacture of ties for women's pattens, &c. I make a composition as follows:—Common glue size, in a state of jelly, about one part; fat boiled linseed oil, about four parts; lamp black, about half a part; white lead, as ground in the mill, about one part; pipe-clay, ground fine, about one part; litharge, ground fine, two parts. When the glue size is sufficiently melted at a moderate heat, add the boiled linseed oil by degrees, keeping the mixture in constant motion, until completely blended, and which will be effected in a few minutes. Then add the lamp black, white lead, and pipe-clay, and litharge, and when all are melted, and quite free from lumps, let the whole simmer for half an hour or more, by which means the composition will become much thicker, and consequently much firmer for the intended purpose; then the composition is ready to apply to the cloth. The readiest mode, I find, is to strain the cloth on a frame (or frames) of such dimensions as is most convenient; and with a proper size pallet knife (or any other convenient way) apply the composition (in a warm state) to the cloth, taking especial care the cloth is well filled with the said composition, so that when dried and cut it is found to be thoroughly saturated. When the cloth is so prepared, let the frames be placed where there is a circulation of air, or in a moderately warm room, according to the season of the year,

as it is material the composition should be dried gradually. When the first coat of composition is found sufficiently dried, add a second, or third, or fourth coat, as may be thought requisite, taking care each additional coat is laid on as thin as possible (as a superabundance would prevent the desired pliability,) leaving the surface every time as smooth as it can be made; and should such care not yield a surface so even as may be wished, let the cloth be cut into strips, of a proper breadth for patten ties, &c. and placed between iron or other plates, and passed through rolls, worked by a horse or mill, or manual power, by which means the surface may be made as even as the plates themselves. When I have proceeded thus far, I take oil or varnish colour, of any tint required; and when these coatings are dry and the surface assumes a japanned appearance, the operation is complete, and the material ready to be cut up into patten ties, &c. such ties, &c. being finished in dies under a press or stamp, similar to raising impressions on paper, metal, or horn. For purposes which do not require to be so elastic, such as for carriage tops, &c. &c. I add glue, size, and pipe clay, and white lead, in such proportions as the nature of the surface demands; and when the pieces are so large as to be inconvenient to pass through rolls, the surface may be rubbed down from time to time with pounded pumice stone, tripoli, &c. and then the oil or varnish colour applied as often as found necessary for the purpose intended.

To Thomas Attwood, *of Birmingham, in the County of Warwick, Manufacturer, for his Invention, and having brought to perfection an Improved Method of making a Nib or Nibs, Slot or Slots, in Copper Cylinders, or Cylinders of other Metal used for Printing Cottons, Linens, Silks, Stuffs, and other articles.* Sealed 26th February, 1825.



In the improved modes of printing silks, calico, and other fabrics, cylinders of copper have, of late years, been employed, in place of flat plates or wooden blocks; upon the surfaces of these cylinders, the subjects to be printed have been engraved, and on the pattern becoming old fashioned, the surface has been turned away, and a new pattern engraved. This necessarily reduced the diameter of the cylinders, and rendered their adaptation to the printing machinery inconvenient, in consequence of not being all of one size, and the appropriation of an entirely new cylinder to every newly engraved sub-

ject being an expensive matter, induced the present patentee to introduce a mode of soldering cylindrical shells of copper upon rollers of iron or steel, and to displace those copper shells, and solder on new ones as often as the subjects required to be changed. For this practice, the inventor obtained a patent in June, 1823.

The present invention is a further improvement in the construction of printing cylinders, to be made of copper, or other suitable metal, which consists in making hollow cylinders for the purpose of introducing an iron or steel axle; these are to be held together by means of nibs, or protuberent pieces falling into slots or recesses.

The iron or steel axle is first to be prepared, as shown at Fig. 1, by turning it in a lathe. At each end of the axle, the shoulders and recesses, *a a*, are formed, upon which it is to revolve in the printing machine, and the middle part of the axle is made nearly cylindrical, very slightly tapering towards one end. A rising piece is to be left at the larger end, for the purpose of forming the nibs or protuberent pieces, *b b*, which are to be cut or filed out of the solid to their shape. At the reverse end of the axle, the recesses, *c c*, are to be made by cutting away the metal; and when this is done, the axle may be considered as complete.

The hollow cylinder shown, detached at fig. 2, is to be made from an ingot of copper turned in a lathe, on the outside to a smooth, and perfectly cylindrical periphery; it is then to be bored on the inside in the following manner. First, make a hole entirely through it; and then, with another tool something larger, bore it again within about two inches of the end, leaving a ledge out of which the nibs, *d d*, are to be formed, as seen in the end view, fig. 3. These nibs are intended to fit into the slots or recesses, *c c*, of the axle. At the reverse end of the hollow cylinder, the internal slots or recesses, *c c*, are formed by cutting away the metal, as shown in the end view, fig. 4; which slots are intended to receive the nibs or protuberent pieces, *b b*, on the axle. The hollow cylinder is to be properly hammered or drawn through a hole, in a steel draw plate, by which the copper will become elongated upon the axle, and adhere to it with firmness.

The advantages of these improved rollers or cylinders for printing, are, that many copper cylinders may be fitted and adapted to one iron or steel axle, and shifted at pleasure, which will save a very great expense in the cost of printing cylinders; and when the engraved subjects require to be changed, another cylinder may be put upon the axle, and made fast by drawing through a steel hole as above mentioned; which improvements are said to produce stronger rollers than those made of solid copper, and less expensive, which is a great object, as the same copper is not applicable to printing rollers after having been re-melted.

The patentee concludes by saying, though I have shown in the drawing, three nibs and three slots in each cylinder and axle, I do not mean to confine myself to that number, as one or two may be sufficient under some circumstances, or three, four, or any other number may occasionally be found desirable; neither do I mean to confine myself to any particular dimensions, as that will depend upon the goods to be printed.

FOR THE FRANKLIN JOURNAL

MECHANICAL JURISPRUDENCE.—No. 6.

BY P. A. BROWNE, ESQ.

*On Mechanics' Liens.**

As regards the lien of the Vender of a Lot.

Rule. If the owner of a Lot makes a parol agreement to sell it, and puts the Vendee into possession, who proceeds to erect a building thereon, and, in so doing, contracts debts with mechanics and material men, the claim of the vender, for the purchase money, will be preferred to those of the lien creditors.

The case, in which this point occurred, was Kline *v* Lewis in the Court of Common Pleas of Philadelphia County in 1820. MS. [decided by Judge Hallowell.]

As regards a rent.

Rule 1. If a Lot is granted on a perpetual rent charge, and the grantee afterwards builds a house, in doing which he contracts debts to mechanics and material men, their claims must be deferred to the rent.

Rule 2. But if, after the commencement of the building, the premises are incumbered with a rent charge, the claims of the mechanics and material men will be preferred.

Rule 3. The owner of a Lot and building, upon which mechanics' liens have been created, cannot make a lease for years of the premises to the prejudice of the mechanics and material men.

This principle may be collected from the reasoning and admissions in the case of M'Call *v* Lenox in the Supreme Court, 1823. [MS. That case was as follows. Peter L. Berry being seized in fee of a house and lot, the N. W. corner of Chesnut and Tenth Streets, mortgaged it to Thomas Armstrong by deed, dated the 12th Sept. 1813. Berry retained the possession, and afterwards, on the 4th February, 1814, made a second mortgage, accompanied with a judgment bond, to Miles H. Hughes, who assigned this mortgage and bond to Daniel Man. On the 5th of May, 1814, Berry made a lease to the plaintiff, (who was then in possession, under a former lease from Berry,) for the term of two years, to commence on the 1st of May, 1815, on which the plaintiff paid all the rent in advance. On the 4th of February, 1815, Daniel Man, assignee of Hughes, entered judgment against Berry, on the bond which accompanied his mortgage, and by virtue of a *fieri faciàs* and *Venditioni Exponas* issued on this judgment, the mortgaged premises were taken into execution and sold to the defendant, who received a deed from the Sheriff, dated 3d November, 1815. The purchase money was applied first to the payment of Armstrong's mortgage, and afterwards to the payment of Man's, as far as it would go, but was not sufficient to pay the whole. It was contended by the plaintiff, that the lease made by Berry was

* The last essay was, by mistake, marked No. 4. It ought to have been 5. The present number completes the subject of Mechanics' Liens, the next will commence that of the Patent Laws of the United States, and of England.

good against the defendant, who was the purchaser at Sheriff's sale; but a majority of the court were of a different opinion, and part of the reasoning and admissions of all the judges, will apply with equal force to the case of sale, under a mechanics' lien, where the lease is made *after* the commencement of the building.

The 4th general question regards the *time* the lien may exist.

This leads to the following considerations.

1. When the lien is *indefinite.* 2. Whether it is necessary that it should be *revived* like a judgment. 3. What will operate as an *extinguishment* or *destruction.* 4. When it is limited.

1. *When the lien is indefinite.*

Rule 1. If an action for the recovery of the lien be instituted or the claim be filed, in the office of the Prothonotary of the county, within six months after performing the work, or furnishing the materials, the lien is *indefinite as to duration.*

This is the necessary consequence of the first proviso in the 1st section of the law of 1806, namely, "Provided always that no such debt for work and materials *shall remain* a lien on the said houses, or other buildings, longer than two years from the commencement of the building thereof, unless an action for the recovery of the same, be instituted, or the claim filed within six months after performing the work, or furnishing the materials, in the office of the prothonotary of the county."

If the suit is brought or the lien is filed within the six months, the condition is performed, and the lien *does* remain *longer than two years;* but how long, the legislature have not said; therefore, its duration is *indefinite.*

2. *Whether it is necessary that it should be revived like a judgment.*

A mechanic's lien does not require to be revived by a *scire facias,* like a judgment.

* In the case of Knorr *v.* Elliott, and another, 5th Sergeant & Rawle, 49, it was endeavoured to establish the position, that the mechanics' lien, when filed, was in nature of a judgment; and that, therefore, like a judgment, it must be limited to five years, as judgments are, by the act of the 4th day of April, 1798; but the court were of opinion that it did not expire at the end of five years.

3. *What will operate as an extinguishment or destruction.*

Rule 1. If the lien creditor performs the condition of the 1st section of the act of assembly, by filing his claim within six months, his lien will not be injured by his taking a bond and warrant of attorney for the amount of his debt and entering it up in the Prothonotary's office.

* By an act of assembly, passed the 4th April, 1798, it is enacted, that "no judgment thereafter entered, in any court of record, within this Commonwealth, shall continue a lien on the real estate of the person against whom such judgment may be entered, during a longer term than five years from the first return day of the term of which such judgment may be so entered, unless the person who may obtain such judgment, or his legal representatives, or other persons interested, shall, within the said term of five years, sue out a *scire facias,* to revive the same."

The ground upon which it was contended that such a lien was defeated, was this. It is a rule of law, that the acceptance of a *higher security* than the creditor had before, is an *extinguishment* of the first debt. It was contended that the bond and warrant of attorney, was a security higher than the simple contract debt of the lien creditor, which operates as an extinguishment; and again that the judgment which was a still higher security, had the same effect. But the court were of opinion, that the lien, when filed, was a security superior to the bond, and as to the judgment, *that* did not destroy the lien, owing to the peculiar nature of it, under the provisions of the act of assembly. That although there was a judgment, yet there still existed, in contemplation of the act of assembly, *a debt on account of materials furnished to the building*. The case will be found in 2 Browne's rep. 207, the case of John Thompson.*

With respect to the *destruction* of a lien, the following are the most important points.

Rule 1. A sale of the premises by the sheriff, under legal process, destroys the lien upon the building; thenceforth the purchaser holds the premises clear of the lien, and the mechanics' and material men divide the fund created by the sale.

Rule 2. And this will be the effect, whether the sale is made under a mechanic's lien or under a judgment.

In the case of Gorgas, &c. *v.* Douglas, reported in 6 Sergeant and Rawle, 512, it was made a question, whether a subsequent judgment creditor could sell a property liable to mechanics' liens, so as to discharge it therefrom.

It was said that the lien operated as a pledge of the specific property, which can be relieved only by payment of the whole debt, or by payment of part under a *sale by a lien creditor*. But the judges of the District Court were of a different opinion; they said that the act of 1806, did not prohibit, but contemplated a sale of the premises by *any* creditor, and a distribution of the money *pro rata;* but prefers the lien of the material men, &c. before other liens, originating subsequent to the commencement of the building. If a sale could be made for the mechanics' liens only, then a judgment creditor might be delayed, till the property was wasted; whereas, there was no inconvenience in allowing *any* creditor to sell.†

4. *When it is limited.*

Rule 1. If the lien is *not* filed, nor the suit brought within six months after performing the work, or furnishing the materials, the lien remains two years from the commencement of the building, *but no longer*, and therefore where no claim is filed or action brought

* It is proper here to remark, that Judge Duncan, in delivering the opinion of the Supreme Court, in the case of Williams *v.* Tierney, 8 Sergeant and Rawle, 58, makes use of this expression—"It is not required to give an opinion whether the taking a bond with warrant of attorney, and judgment confessed on it, extinguishes the lien, a matter which, when it comes in judgment before the court, will require very grave consideration."

† Upon this point the Supreme Court gave no opinion

within six months, but a suit was instituted and judgment obtained within two years, and the building was sold *after* the expiration of two years, the *judgment creditors* were preferred.

In the above case it was confessed, that the lien creditors did not bring themselves within the words of the law, for they had not sued or filed their liens within the six months, but the merit of their claim over the other judgment creditors, rested upon the circumstance of their having instituted suits and recovered judgment *within two years*. But this did not avail them. Hemphill, President, delivered this as the opinion of the court.

The 5th general question relates to the *manner of entering a lien*, or instituting a suit.

As respects entering a lien, we must attend to *the form*; *the substance*; and to *joint liens*.

As respects the suit, *whether entering up a bond and warrant of attorney is a suit?—Where the suit must be brought?*

The form of entering a lien.

The Act of Assembly points out no particular *form* of the claim to be filed in the office of the Prothonotary, and various forms have been used. But the following rules must be observed.

Rule 1. As the object of the filing the claim is to give notice of the incumbrance, the building should be described with *convenient certainty*, that persons searching the records may know against *what* house it is that the claim is filed.

There is a case now pending in the Supreme Court, where the question is, whether the following description is sufficient, "a three story house on the south side of Walnut Street, between Eleventh and Twelfth Streets."

Rule 2. The *owner* or *reputed* owner's *name* is mentioned.

This is done that the lien may be found upon searching in the name of the person; the index or roll being kept in alphabetical order, for the convenience of search.

Rule 3. The creditor is described by his *business*.

As the law grants him the lien in his *character* of *mechanic* or *material man*, that character ought to be *stated*, that the Court may judge whether he is included in the terms of the Act of Assembly.

Rule 4. The *kind of work* or *materials* are particularly described.

This is also done that the court may judge whether they are of the *description* contemplated by the act.

Rule 5. The *amount* should be stated,

That persons wishing to purchase, or loan money on the premises, may know what is the amount of the claims.

I would further observe that the act contemplates the *real* amount to be mentioned, for it provides, that in case, after payment, satisfaction is not entered, any sum not exceeding one half *the debt* for which the claim was filed shall be recovered.

Of *Joint Liens.*

Rule 1. Several *houses belonging to the same person* are sometimes included in one general lien. The District Court for the City and County of Philadelphia have decided this to be incorrect.

Rule 2. If materials are furnished to *several* houses belonging to *several* persons, and a joint lien be filed, it will be *void.*

This was decided in the case of Gorgas, surviving partner of Warner, *v.* Douglass. Warner and Gorgas, lumber merchants, filed their claim against Francis Douglass, owner or reputed owner, for materials furnished in erecting *three* houses. Douglass was the owner of *one* house only, and acted as *agent* for the owners of the other two, and the question decided was, whether the lumber merchant could file his claim affecting the *three houses jointly*, and making *each* liable for the whole debt.

Rule 3. If a joint lien is thus improperly filed against several houses owned by *several* persons, the party will not be permitted, at the trial, to give evidence of what lumber was furnished to each house, to ground a *separate* recovery. This also was decided by the Court in Gorgas *v.* Douglass, 6 Serjeant and Rawle, 512.

Respecting *the suit.*

Rule 1. The lien may also be perpetuated by *instituting a suit.*

Rule 2. But taking a bond and warrant of attorney, and entering a judgment on it, is not instituting a suit within the meaning of the Act.

This question came before the Supreme Court in the case of Williams *v.* Tierney, reported in 8 Serjeant and Rawle 58. The case was this, the mechanic who had done work for a building, took the owner's bond and warrant of attorney for the amount, and entered up judgment thereon, but he filed no claim in time, nor instituted any suit on the original account. The only question was, whether that preserved the lien, and the court decided that it did not.

Where the *suit* must be brought.

Rule. The action contemplated by the act, must (in this County) be instituted in the Court of Common Pleas, District Court of the City and County, or the Supreme Court; an action brought before an *Alderman* or *Justice of the Peace* will *not* suffice.

This was decided by the Judges of the District Court, for the City and County of Philadelphia, in the case of Sharp *v.* Reese, in April, 1816.

We must, 6thly, inquire into the *proceeding* to recover the amount of a lien.

Under the law of 1806, the remedy was *personal only.*

The act of assembly of 1806 gave no remedy to recover a lien but a personal action, which, for want of a proper person on whom to serve the process, often occasioned a failure of justice. It was to remedy this inconvenience, that the 2nd section of the act of 1808 was passed. By this act, the proceedings to recover the debt of the mechanic or material man are twofold. 1. By personal action against the debtor, his executors or administrators. 2. By *scire facias* against the debtor and owner of the building, or their executors and administrators.

When a personal action is brought, it has been usual to insert in the declaration, that the work was done, or the materials were found and provided for, or in the erecting and constructing of the dwelling house or other building (describing it.) This practice is convenient,

as it facilitates the means of inquiry into the claims, but it would seem from an expression in the opinion of the court, (Duncan J.) in Williams *v.* Tierney, that it is not absolutely necessary. See page 60, 8. S. & R.

Rule. If the remedy is by *scire facias*, it must necessarily follow the nature of the contract; and the plaintiff's must be the same as if a personal action in assumpsit had been instituted. And therefore if *one* of several persons who ought to have joined in such *scire facias* brings an action alone, it may be taken advantage of on the *general issue.* The case of Howard *v.* M'Kowen, 2 Browne's report, 150, was this; Howard and Wharton furnished lumber for a building; they afterwards dissolved partnership, all the debts being transferred to Howard, and a claim was filed, and a *scire facias* was issued in the name of Howard. It was objected that the claim ought to have been filed, and the scire facias entitled in the name of the *firm;* and of this opinion were the court.

The 2d section of the act of 1808, directs, that the *scire facias* may be served in like manner as a summons, (that is, by delivering a copy, personally, or leaving it at the dwelling house, with one of the family;) if they can be found, within the county in which the building is situate, or are resident therein, or by fixing a copy of the writ upon the door of the building against which the claim is filed.

Upon the return of service and non-appearance, the court are authorized to enter judgment, as in case of a summons, that is judgment by default.

As the writ discloses the whole cause of action, no declaration need be filed. Ridgway *v.* Hess, 1 Browne's rep. 347.

If the defendants appear, they may plead and make defence, and the like proceedings shall be had as in personal actions for the recovery of debts.

The pleas generally put in, are *non-assumpsit*, that the defendant did not assume to pay the debt, or *payment.* The judgment rendered in the *scire facias*, warrants an execution to issue, only, against the building or buildings, upon which the lien existed.

The proviso says "that no judgment rendered in such *scire facias*, shall warrant the issuing an execution, *except against* the *building* or *buildings* upon which the lien existed, as aforesaid."

The consequence of a deficiency of assets to pay all the lien creditors, is the next division of our subject.

It often happens that the building and lot when sold, do not together, yield enough to pay for the work and materials expended in the erection of the building. The act has provided for these cases by declaring that "if such house, or other building, should not sell for a sum of money sufficient to pay all the demands for work, and materials, then and in such case, the same shall be averaged, and each of the creditors paid a sum proportioned to their several demands."

In order to ascertain the amount of the liens, it is the practice of the court, *with the consent of the parties*, to appoint a commissioner, who collects all the facts and lays them before the court.

But this is by consent, for in the case of Lyle v. Ducomb, the judges of the Supreme Court disclaim any such authority.

The court have power to direct an issue to be formed to try disputed facts.

The eighth and last head, is the *duty of the lien creditor* upon the receipt of his debt.

Rule 1. It is the duty of every lien creditor as soon as he has received satisfaction of his demand, to enter satisfaction upon the record of his lien.

This is required by the 2d proviso of the 1st section of the act of 1806.

Rule 2. And if satisfaction is not entered, a suit may be instituted, and any sum not exceeding one half the debt may be recovered.

In the paper by Mr. Bull, on the subject of fuel, that gentleman has described his method of obtaining charcoal, by surrounding the pieces of wood to be charred, with pulverized coal, by which a product is afforded, equal in every respect to that made in cylinders, or retorts of iron, (see p. 277, 278) The editor has seen some of the charcoal made upon this plan, in the large way; its superiority to that produced by the common process, was very striking. The plan proposed can be pursued with facility, and without expense; and the great saving of wood, from the increased quantity of coal obtained, is a circumstance which renders it of national importance.

Perhaps the surest mode of calling the attention of those more immediately interested, would be for Mr. Bull to obtain a patent for the process. That for which we are forced to pay, we are most apt to value.

Observations on an improved mode of Charring Wood, in the large way. By Marcus Bull.

From the experiments mentioned, p. 277, 278, it occurred to me, that an important improvement might be made in the common process of making charcoal, by filling the interstices between the sticks of wood with the culm, or fine coal, left on the ground after the large coal has been drawn from the pit; and by covering the wood more perfectly than is usually done. In this way we may more completely prevent the access of air, which is not only destructive, in many cases, to a large portion of the coal, but also renders what remains less valuable.

That my remarks on the subject may not be considered as entirely theoretical, it is proper to state, that an intelligent collier in New Jersey, applied, in a partial manner, the plan proposed. He found the product to be about 10 per cent. more in quantity, *by measure*, than he had ever before obtained from the same kind and quantity of wood: and I also found the coal, when brought to market, nearly 20 per cent. heavier than usual. As an evidence that the coal had been well charred, (a circumstance too often neglected) the hy-

drogen appeared to have been almost entirely expelled, as it lost very little in weight by exposing it to a red heat in powdered charcoal.

The quality of this coal was considered by competent judges to be superior to any other ever offered in this market; it was as cleanly to handle as anthracite coal, and sold readily at an advanced price.

From an examination, made during the last summer, of the common manner of piling and covering wood which is to be converted into charcoal, the practice of piling it two, and sometimes three tiers in height, appeared to be objectionable for two reasons; the first was, that the second and third tiers cannot be so well defended from the air as the first, which rests upon the ground; this being a better barrier against the air, than the ordinary covering can be made to present; and the second that this disposition of the wood is not favourable for producing the ignition of the whole mass at one and the same time; the usual practice being either to commence the ignition in the centre of the upper tier, or, to drop the fire into a hole, or chimney, left in the centre of the pile, which extends to the bottom, or ground; leaving air holes also, at the sides, by which, (to use the language of the colliers,) the fire is said to be drawn to the sides of the pit.

It is very true, that the fire does eventually extend to the sides of the pit; but a much more uniform and speedy process, and one by which less loss would be sustained, would be to place the fire, in the first instance, in a number of holes at the sides, near the bottom, leaving an opening at the top, by which the heat generated at the sides, would be communicated to the wood in the interior, and facilitate the uniform ignition of the whole mass; at the moment this is effected, the holes at the sides should be closed, and that at the top might be lessened, but should not be wholly closed, until the extrication of hydrogen gas has nearly ceased, as this gas, from its prodigious expansion, sometimes bursts the pit; this generally occurs when the wood is well covered, and sometimes produces very injurious effects, by firing the adjacent woods, (the column of flame having been known to extend from twenty to thirty feet,) and has probably led many colliers into the belief, that the proper remedy is to give the wood a slight covering, by which numerous escapes are allowed for the gas; but in effecting this object, as the holes at the sides are left open, a very strong current takes place through the pit, from the slightness of the covering, whilst another evil is produced, that of burning through the sides of the pit.

In those instances where pits have been known to burst, when well covered, the cause may probably be traced to the chimney at the top, having been too soon closed, this being generally done in about fifteen minutes after lighting the fire: and also, to having left those at the the sides open too long: as the gas will make its escape in some manner, this should be provided for; this provision is as necessary to a coal pit, as is the safety valve to a steam boiler.

Both the objections which I have made, against piling the wood two or three tiers high, may in part be remedied by changing the manner of igniting the wood, in the way proposed; and if clay and sand can be procured, the former should be used as a covering, and

the latter placed on the top to fill the cracks as the clay dries, these should be preferred in all cases, and the evils may thus be lessened; but undoubtedly, the best manner is, to pile the wood in single lengths, and if the fine coal is used to fill the interstices, and can be made subservient in its combustion to produce the required heat, or any portion of that necessary to char the wood, that portion which can be so used, is as effectual as the combustion, and saves an equal portion of the charcoal. The process being, when conducted in retorts, similar to that of distillation, those portions of the wood, which it is necessary to expel being volatile, no necessity exists that any combustion should take place either in the wood or coal: yet this cannot be entirely prevented, in the common process, unless some means be devised to burn the hydrogen gas which escapes, and make it applicable to produce the heat necessary to char the wood, as is done when the process is conducted in retorts. The hard texture of the coal will be in proportion to the heat given to it, and the perfect exclusion of the air; the advantage therefore of using clay will be obvious, from its being a bad conductor of heat, and a good barrier to exclude the air.

I have been informed by a gentleman well acquainted with the iron works in this state, that in consequence of the growth of the extensive forests belonging to the works, not being sufficiently rapid to furnish a constant supply of charcoal, many of them are obliged to suspend their operations, about three months in each year, by which very great loss is sustained. If an improvement can be made in the manner of producing the charcoal required, by which these works, and all others similarly situated, shall be enabled, from their present forests, to continue their operations, during the whole year, without interruption, such an improvement must be considered as important, not only to individuals, but to the community generally.

It is my intention, so soon as my other avocations will permit, to make some further experiments in the charring process in the large way, and to use the fine coal as suggested; for which purpose a number of cords of wood have been cut for a considerable period of time.

Observations on the experiments which have been made to ascertain the law which obtains in the cooling of heated bodies; and on the applicability to that purpose, of the apparatus used in the "Experiments to determine the comparative quantities of heat evolved in the combustion of the principal varieties of wood and coals, &c." By* MARCUS BULL.

Numerous experiments have been made to determine the law which obtains in the cooling of heated bodies. My apparatus, although it did not admit of making experiments on this subject at high temperatures, yet appeared in one respect better adapted for the purpose than any other which has, to my knowledge, been made use of; because we are enabled by it, to maintain both the heated body, and the re-

* This article originally made part of the paper published in our last number.

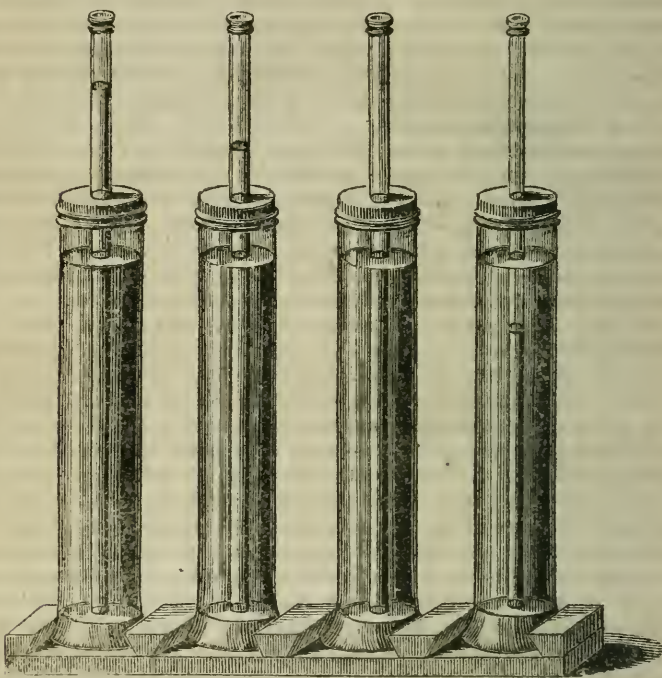
frigerating medium, at the same *difference* of temperature, for a sufficient period of time, to determine the question with accuracy. My experiments consisted in maintaining the temperature of the interior room 10°, 20°, 30°, and 40° above the temperature of the exterior room for the same period of time; and the quantity of fuel required was found to be directly proportioned to the increased difference in temperature. These results are in agreement with the assumption of Newton, with the geometrical law of Richmann, and correspond also at these differences of temperature, with the experiments of MM. Dulong and Petit; although the latter gentlemen found very different results at higher temperatures.

The usual method which has been adopted to determine this question, by finding the period which fluids, when heated, require to cool through a given number of degrees in different parts of the scale of a thermometer, appears liable to some objections, which it becomes me, however, to notice with deference. The form or size of the containing vessel is not, perhaps, material, but as spheres have been most generally used, my remarks will be confined to that shape.

We will, for illustration, assume the containing vessel to be the bulb of a thermometer two inches in diameter, and filled with mercury. This we will suppose to be heated to 300° of Fahrenheit, and placed *in vacuo*, in which case it is said to lose its heat by radiation only. Now, as the stratum of mercury in contact with the bulb, parts with its heat, it contracts and occupies less space in the bulb, which causes a portion of that within the tube to sink into the bulb in order to supply the deficiency. This exterior stratum must then be supposed, from its loss of heat, to have acquired greater density, and to leave the sides of the bulb; hence, *motion* in the fluid commences, and in proportion to its heat will be its mobility, and consequently, the velocity with which the change will be made, and as the strata lessen in volume as they approach the centre of the bulb, their heat must either be transmitted through the exterior intervening strata, or be subject to the necessary delay in coming in contact with the bulb, in consequence of the decreasing velocity with which the changes are made; and, in either case, the cooling process will be retarded. If we suppose the fluid, under the circumstances described, incapable of locomotion, it will not be denied that the interior strata will require more time to impart the same heat, than the exterior, consequently, proportional to the cooling of the body must be the increased time required to deprive it of any given number of degrees.

Experiments upon this subject would be much more satisfactory, and would probably give different results from those hitherto obtained at high temperatures, by using an apparatus which should admit of maintaining the heat at fixed points upon the scale of the thermometer; in which case, motion in the fluid would be immaterial, and an equally heated surface would always be exposed to the refrigerating medium.

A NEW METHOD OF DEMONSTRATING THE EXISTENCE, AND THE EXTENT, OF THE PRESSURE OF THE ATMOSPHERE. BY ROBERT HARE, M. D. PROFESSOR OF CHEMISTRY IN THE UNIVERSITY OF PENNSYLVANIA.



For the pressure of any fluid upon any area assumed within it, the pressure of a column of any other fluid, having the said area for its base, may be substituted; provided the substituted column be as much higher, as lighter, as much lower, as heavier; or, in other words, the heights of the respective fluids must be as their gravities, inversely.

Let there be four jars, each about four inches in diameter, and more than thirty inches in height—severally occupied by mercury to the depth of about two inches. In the axis of each jar, let a tube be placed, of about one inch and a half in diameter, and about one-fourth taller than the jar, with both ends open, and the lower orifice under the surface of the mercury. On pouring water into the jars, the mercury rises in the tubes, as the water rises in the jars; but the mercury rises as much less than the water, as it is heavier.

The mercurial columns are evidently elevated by the pressure of the surrounding water, and, by their height, measure the extent of that pressure on the areas, of their bases, respectively. They may be considered as substituted severally for the aqueous columns, which

would have entered the tubes, had not the mercury been interposed. Accordingly, water being poured into one of the tubes, the mercury in that tube, subsides to a level with the mercury without; when the water (poured into the tube) reaches the level of the water without.

In this experiment, columns of mercury have been substituted, in water, for columns of this fluid, and are found adequate to preserve an equilibrium with it, being as much lower as heavier. It remains to be proved, that other fluids, heavier, or lighter, than water, may in like manner be substituted for the columns of mercury, and of course for the water, of which the mercury is the representative.

Into the three tubes, in which, by the addition of water in the jars, columns of mercury are sustained, pour severally, ether, alcohol, (differently coloured, so that they may be distinguished) and a solution of sulphate of copper, until the mercurial columns within the tubes are on a level with the mercury without. It will be found, that the column formed by the cupreous solution, is much lower than the surface of the water on the outside of the tube: that the opposite is true of the column of alcohol; and that the ether (still more than the alcohol) exceeds the surrounding water in elevation.

While it is thus proved, that columns of mercury, ether, and alcohol, or of a saline liquid, may, in water, be substituted for columns of this fluid; it is made evident, that they must be as much higher than it, as lighter; as much lower, as heavier.

Pursuant to the law, which has been thus illustrated, that the pressure of one fluid may be substituted for that of another; provided, any difference of weight, be compensated by a corresponding difference in height; if, in lieu of water, the mercury were pressed by air on the outside of the tubes, unbalanced by air within, a column of the metal would be elevated, which would be in proportion to the height, and weight, of the air thus acting upon it.

In order to show that the air exercises a pressure analogous to that of the water on the surface of the mercury, outside of the tubes, in the experiments just described, it is only requisite, that this external pressure be unbalanced by the pressure of air within the tube.

This desideratum is obtained, by filling with mercury, a tube about three feet in length, open at one end, and closed at the other, and covering the open end, with the hand, until it be inverted and immerged in a vessel containing some of the same metal, without allowing any air to enter. A mercurial column of about 30 inches in height, will remain in the tube, which must be supported by the pressure of the surrounding air, and be an index of its weight. This is a case obviously analogous to that of the mercurial columns, supported by aquatic pressure, in the experimental illustration above afforded.

Supposing the base of the column of mercury thus sustained by the atmosphere, were equivalent to a square inch, the total weight of the column would be about fifteen pounds. This of course represents the weight of that particular column of air only, whose place it has usurped; and as, for every other superficial inch in the earth's surface, a like column of air exists, the earth must sustain a pressure from the atmosphere, equal to as many columns of mercury, 30

inches high, as could stand upon it; or equal to a stratum of mercury, of the height just mentioned, extending all over the surface of the globe.

It has been shown, that the height of heterogeneous fluids, reciprocally resisting each other, are inversely as their gravities; or, in other words, that they are as much higher, as lighter; as much lower, as heavier. The height of the column of air which, by its pressure, elevates the mercury, must, therefore, be as much greater than the height of the column of mercury, as the weight of the mercury is greater than the weight of the air; supposing the air of uniform density. Mercury is 11152 times heavier than air, and of course the height of the atmosphere would be (if uniform in density) 11152 × 30 inches = 27.880 feet; supposing 30 inches the height of the mercurial column supported.

Hence the atmosphere, if of the same density throughout, as on the surface of the earth, would not extend much above the elevation ascribed to the highest mountains.

But as the pressure of the atmosphere causes its density, it may be demonstrated, that, the heights increasing in arithmetical progression, the densities will decrease in geometrical progression. Thus the density at 3 miles being, by observation, one half of what it is at the surface of the earth;

At 6 miles it will be	$\frac{1}{4}$	At 18 miles it will be	$\frac{1}{64}$
9 - - - - -	$\frac{1}{8}$	21 - - - - -	$\frac{1}{128}$
12 - - - - -	$\frac{1}{16}$	24 - - - - -	$\frac{1}{256}$
15 - - - - -	$\frac{1}{32}$		

or, rarer than we can render it by the finest air pump.

These results have been verified, to a considerable extent, by actual observation.

Observations on the May-Bug, and its ravages on Plum, and other Trees, and also on the means of preventing the mischief.

New Jersey, May 23d, 1826.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir—Being convinced, by observation, and by reading several papers on the subject, that our plums were stung by an insect for the purpose of depositing its egg, and having often seen the egg and the worm when hatched, I was determined both to learn the history of the insect, and to endeavour to prevent the mischief it caused.

The insect of which I speak, is called by some, the May-bug, or Doree-beetle. It belongs to the order *coleoptera*,* and it deserves the attention of every one interested in agriculture and horticulture. In three months after the eggs are deposited, either in the plum, cherry, apricot, peach, nectarin, or in the earth, this insect assumes the form of a small grub or maggot. If it be deposited in fruit, it works its way to the kernel, and the circulation being destroyed by its ravages, the fruit falls to the ground. The worm then crawls downwards, and finds its way to the roots of vegetables, on

* *Scarabæus Melolontha.* Linn.

which it subsists for *three years*, going lower and lower into the earth every winter as it increases in strength and size. When it has attained the size of ½ an inch caliber, and from an inch to 1½ inches in length, and has remained in the grub state for three years, committing every sort of waste and destruction; it digs its way down in the earth to the depth *of* 6 *or* 7 *feet*, when it scoops out for itself, a commodious habitation. It here shortens itself, swells, and finally bursts its last shell, and assumes the form of a chrysalis. This occurs in January or February, and in a little time, the beetle is formed. It remains in an inert and imbecile state, under ground, until the beginning of May, when it again commences its ravages, and after stripping the trees of their leaves, and perpetuating its species, it either returns to its holes and perishes, or else (its thirst being very great at the close of its career) it flies to ponds and rivers, and is seen no more. This is the formidable insect that preys on the industry of man. This is the *corn grub*, the *cut worm*, the *wood maggot*, the *potatoe worm*, the *cabbage worm*, and in short, occasions the loss of our Indian corn, of our cabbage, of our potatoes, of our fruit, and of our trees. There are many varieties of this mischievous insect, but this chesnut coloured beetle, is the worst, for its life is continued to four years, and at every stage, it does an immensity of mischief. It has unfortunately happened, that the rotation of crops in our district, has been favourable to the increase of this insect. Clover grounds and grasses, of every kind, being its hiding place during the day, whilst in the fly or beetle state. They are this year, more numerous than I have ever known them, at least, it so appears to me now that I have begun to understand their movements. I have thus far, at certain points, defended myself from their attacks, and if I ultimately succeed, I shall be well repaid for the labour it has cost me.

It is *possible* that pungent odours *may* deter them from alighting on a tree, but I doubt it; *actual manual* labour is the only preventive to the scourge. As soon as I became acquainted with their movements, and saw, or rather heard that they had commenced their destructive work, for they only leave their holes at dusk, I began to work. I spread a large sheet or wagon cover under a tree, and giving the trunk a sudden blow with the flat of the hand, the beetles fell on the cloth. Some young plum trees had from 40 to 60 large beetles clinging to their limbs, and leaves; but the slightest touch makes them drop as if dead. As soon as they dropped, I had them gathered and thrown into a *tin* pail of water, that was brought for the purpose. In this way I cleared 50 trees in half an hour. Two persons held a light, and two picked up the beetles. The quantity that we picked up the first night, is incredible. At dusk, the second night, we began again, and had not quite as many as the first night. They were reduced in number every succeding night; and last night I only found one or two on each tree, whereas, on the English walnut, and European ash, and other trees near them, I saw them as thick as ever. One plum tree, that stood a little out of our way, but which we had always stripped of the beetles, was forgotten last night, and I ob-

served, this morning, that several of the plums were stung. In a few nights, I think that these trees will be safe, for when they once commence laying their eggs, they disappear. The trouble is not worth a thought, compared to the benefit derived from it; I hope by ploughing deeply in the fall, and early in April, that I shall in a few years, get rid of these destructive insects. I am induced to believe, that the same set of insects frequent the same tree, and return to the same holes, that they occupied during the day. They are not more than ten minutes from the time that they first fly from the ground, until they all fasten themselves on a tree, and I think that if I could have staid that time at one tree, but very few would have been found afterwards on *that* tree, but I was obliged to go very quickly from tree to tree; of course many alighted on the same tree, after we left it. No one in my neighbourhood, this season, was aware of their existence; nor has any one pursued the same method of extirpation that I have; but I have taken great pains to make every one acquainted with the minute history of the beetle, and of my mode of destroying them; I hope that many others, now, will go seriously to work by fall ploughing, and by watching them in the month of May. I have entirely banished the peach worm, or fly, and I am certain that I can rid myself of the beetle.

I tried small bonfires, but although I destroyed myriads of ephemera, and many millers, yet but few beetles were either attracted by the light, or deranged by the odour.

I observe, too, that the locust is making its appearance, my woods are full of them. I am fearful that they are going to be troublesome.

A.

Society (in France) for the Promotion of National Industry.

This Society was established in Paris, many years prior to the revolution; after suspending its operations, it was revived in 1804, by the association of a number of persons eminent for their learning, statesmen, landholders, manufacturers and others, distinguished for the liberality of their views.

Its principal object is to second the efforts of the French government, for the improvement of all the different branches of National Industry. 1st. By the distribution of prizes and medals. 2d. By instituting experiments, to test the value of new processes. 3d. By advancing funds to aid artisans and manufacturers, in the construction of machines, and the completion of processes, of evident utility. 4thly. By the publication of papers, containing descriptions of discoveries relating to the useful arts, whether made in France, or in foreign countries; with drawings of such models, or machines, as may require them.

Such are the means adopted by the Society, for the attainment of the end proposed. Among the premiums offered we find the following:—

For the construction of a rasp, and of an economical press, for ex

tracting the juice from beet root, for the purpose of manufacturing sugar, 2,700 francs.

For the manufacturing of paper, from the bark of the paper-mulberry tree, 4000 francs.

For the construction of a machine capable of shaving the hair from skins, so as to be suitable for the manufacturing of hats, 1000 francs.

For the construction of a mill, to clean buckwheat, 600 francs.

The following are the conditions, to be observed by applicants.

All models, memorandums, descriptions, patterns, &c. must be forwarded free of expense, to the office of the secretary of the Society, *Rue du Bac.* No. 24.

They must be forwarded before the first of May, in each year. The processes, and descriptions of machines, will be examined by a committee of the Society.

Foreigners are admitted as candidates. Should prizes be awarded to foreigners, the inventions are to be the property of the Society, excepting they are carried into operation, or a patent obtained for them in France.

Competitors are not to insert their names in their memorandums, but to inscribe a motto; this must be accompanied with a sealed paper, with the same motto on the outside, and containing their names and residences.

Persons who obtain prizes, are at liberty to secure their inventions by patent. *Bazar Parisien.*

New Patents for Inventions and Improvements, issued in the United States, from March 11th, to April 12th, 1826.

Improvement in the mode of dipping candles, March 11, William Day, Gardiner, Maine.

Being a machine for raising stumps, March 15, Abiezer H. Whitney, Bowdoinham, Maine.

In the mode of measuring garments, March 15, Stephen Severson, Baltimore.

In making shutters and doors fire-proof, March 16, J. Brown and G. W. Robinson, Providence, R. I.

Called the "ladies' spinner," March 16, George W. Robinson, Providence, R. I.

In the currying knife, March 17, Freeman Palmer, Littleton, Grafton county, New Hampshire.

In making paddle or culvert gates, March 17, Daniel Rodgers, Little Falls, Herkimer county, New York.

In concave and convex mill stones, March 18, J. Sawyer and E. Clark, Royalston, Mass.

In the spiral spring truss, March 21, Bela Farr, Norwich, Chenango County, New York.

In machinery for propelling machinery, March 22, James Cooper, Staunton, Augusta County, Virginia.

In the evolution of heat, March 23, Eliphalet Nott, Schenectady, New York.

In making bolts to locks for doors, &c. March 24, J. Brown and G. W. Robinson, Providence, R. I.

In the steering wheel for vessels, March 24, John M. Brown, Boston.

Called a sight-gauge for a steam boiler, March 24, Wm. Barker, Kingston, Luzerne County, Penn.

In the machine for dividing timber, March 25, do. do.

In the machinery of the pendulum and lever power, March 25, Atrice and Cyrus Berry, Pleasant Valley, N. York.

In the mode of applying steam, wind and water, as a joint power, March 25, Isaac Garretson, Bellefontaine, Ohio.

In the mode of moulding and striking brick, March 28, James Parker, Gardiner, Maine.

In the mode of preparing and grinding clay, March 28, do. do.

In the machinery for propelling boats, &c. March 29, Chauncey Crafts, Woodbury, Connecticut.

In the gas or vapour engine, April 1, Samuel Morey, Oxford, New Hampshire.

In Dry Docks, April 1, Alonson Place, New York.

In Heating Calender Rollers, for glazing cloth, &c. April 1, Joel Brimhall and Thos. Keyes, junr. West Boylston, Worcester County, Mass.

In the Bedstead Fastenings, April 3, Edwin H. Badger, Petersburg, Virginia.

In Nailing Boots and Shoes by a common last and iron tree, April 5, John Trask, Hadfield, Mass.

In the art of Tayloring, April 5, Greenberry Ross, Carlisle, Kentucky.

In the Cutters used in slitting mills, April 5, Timothy Allen, Plymouth, Mass.

In the mode of sawing shingles, April 6, Oliver Goddard, Bridgeton, Maine.

In the machine for jointing and matching boards, April 8, David Gleason and Hiram Frisbee, Betheny, New York.

In the wheel power for pumping vessels, April 8, Salem Town and Robert W. Oliphant, New York.

In the washing machine, April 12, Richard V. Mudge, Durham, New York.

In the cotton press, April 12, Gideon Glenn, Louisburg, North Carolina.

In the machine for manufacturing paper, April 12, Gardner Burbank, Worcester, Mass.

In the wire harness for weaving, April 12, Ezra Brown, Cazenovia, New York.

In the mode of crooking gun-stocks, April 12, John Schirer, Charleston, S. Carolina.

In the side hill cast iron plough, April 12, John Shephard, De Reuyter, New York.

FRANKLIN INSTITUTE—*Exhibition of* 1826.

Manufacturers and Mechanics are reminded, that the third annual exhibition of the products of their skill, will commence on Wednesday, the 3d of October, in the New Hall, erected by the Institute.

Articles may be deposited at any time after the first of August. Letters, (post paid) addressed to any member of the Committee on premiums, will receive immediate attention. The list of premiums offered may be seen in the first number of this Journal, and may be obtained gratis, upon application to the publisher.

Erratum.—In Professor Renwick's paper, where the fraction $\frac{1}{2885}$, occurs, read $\frac{1}{288,5}$.

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END OF VOL. I.